MARINE FISH, LOCAL ECOLOGICAL KNOWLEDGE, AND THE SPECIES AT RISK ACT IN CANADA: LESSONS FROM THE CASE STUDY OF THREE SPECIES OF WOLFFISH

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Marine fish, local ecological knowledge, and the Species at Risk Act in Canada: lessons from the case study of three species of wolffish.

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Abstract

In the last decade there has been an increased focus on assessing the at risk status of species on a local, national, and global scale. In Canada legislation to assess and protect species at risk comes in the form of the Species at Risk Act (SARA). Three species of wolffish, the Atlantic (*Anarhichas lupus*), Spotted (*A. minor*), and Northern (*A. denticulatus*), have the distinction of being the only fully marine Atlantic Canadian fish to be listed under the Act. This listing was based on limited scientific and behavioural data from a relatively short time series of offshore scientific trawl survey data. It is worth exploring the wolffish listing process and outcomes of the listing, different types of knowledge available on stock status, and their relationship, if any, to listing and to recovery strategies. This multi-method study uses an analysis of stock assessment data for the Northern Gulf of St. Lawrence, on-board observation, semi-structured interviews with Northern Gulf fish harvesters, and a review of existing documents and key informant interviews to understand how wolffish came to be listed and evaluate the degree to which Local Ecological Knowledge (LEK) can be used to strengthen species assessments and endangered species legislation.

All data sources showed that wolffish have always been relatively rare in the Northern Gulf of St. Lawrence. Results from LEK interviews and onboard observations detailed harvester knowledge on wolffish life history, abundance, and biogeography. Harvesters reported their observations on the opportunistic nature of wolffish feeding and the seasonal distributional changes of wolffish over the course of their fishing seasons, which corresponded with wolffish reproduction seasons. Though wolffish meet the COSEWIC criteria for Threatened and Special Concern listings, harvesters reported a lack of declining trends in relative catch rates. This was consistent with ECNASAP data for NAFO division 4R. Onboard observations and interviews reported higher annual variability in catch rates than stock assessment averages. Wolffish sizes seen onboard and reported by harvesters indicated adults (>55cm) are predominately being caught in inshore fisheries. Sentinel mobile data shows an *A. lupus* juvenile:adult ratio of 9.8:1

(n=1940), indicating offshore maturing of juvenile wolffish and a later migration inshore, possibly for reproduction.

Though the SARA legislation is a pivotal step forward in the protection of species at risk, results from key informant interviews showed that implementation in 2003 resulted in mixed views about the benefits and problems associated with the requirement for consultations and incorporation of stakeholder knowledge into the listing process. There are also concerns that the listing process has become more litigious and more challenging for science. There is some evidence that the wolffish listing process has increased harvester stewardship and engagement and benefitted from their input into safe release of wolffish. Finally, little attention has been paid by any of the stakeholder groups consulted to the potential future delisting of wolffish under SARA, which is arguably the most important goal of species conservation. Without delisting requirements or timelines set up in a species recovery plan it is impossible to establish concrete guidelines for recovery.

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List of Acronyms

ATK	Aboriginal Traditional Knowledge
CESCC	Canadian Endangered Species Conservation Council
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch Per Unit Effort
DFO	Department of Fisheries and Oceans Canada
ECNASAP	East Coast of North America Strategic Assessment Project
FFAW	Fish, Food, and Allied Workers Union
ICEHR	The Interdisciplinary Committee on Ethics in Human Research
IUCN	International Union for Conservation of Nature
LEK	Local Ecological Knowledge
NAFO	Northwest Atlantic Fisheries Organization
RV	Research Vessel
SARA	Species at Risk Act

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1. Introduction

In the last decade there has been an increased focus on assessing the at risk status of species on a local, national, and global scale. Many countries, including Canada and the United States, as well as the European Union, now have legislation in place to help not only assess species, but in many cases to protect those species most at risk.

On the International Union for the Conservation of Nature (IUCN) Red List, out of the estimated 31,300 species of fishes described from 1996-2010 (January), only 14% have been assessed (IUCN, 2010). Approximately 32% of those fishes assessed are threatened, the highest percent of all vertebrates. Recent research has shown that many fish stocks have been fished to the brink of commercial extinction; an even greater number of non-commercial species are disappearing from the world due to elimination of habitat and as bycatch in large fisheries and (Dulvy, Jennings, Goodwin, Grant, & Reynolds, 2005).

Decisions to legally protect marine species at risk are primarily based on fisheries science. However, there is a lack of scientific data for many marine species. In Canada, this is reflected in the large number of species assessed by the Committee on the Status of Endangered Species in Canada (COSEWIC) as data deficient.

1.1. History of Species at Risk in Canada

COSEWIC, created in 1977, has the mandate to designate the conservation status of indigenous wildlife species at risk in Canada (Freedman, Roger, Ewins, & Green, 2001; Shank, 1999). It is composed of a panel of experts, including independent scientific experts, conservationists (Bourdages & Labelle, 2003), representatives of four federal agencies (Canadian Museum of Nature, Canadian Wildlife Services, Department of Fisheries and Oceans, and Parks Canada; (Freedman, et al., 2001), three non-governmental conservation organizations (Canadian Nature Federation, Canadian Wildlife Federation, and World Wildlife Fund), and each provincial and territorial government (Freedman, et al., 2001; Shank, 1999).

While species listed by COSEWIC are sometimes granted protection by provincial governments, the COSEWIC list has no legal authority and there are no regulatory consequences associated with listing by COSEWIC. In response to this a list of legally protected species at risk, named the Species at Risk Act (SARA), was passed in 2003. Three federal Ministers are responsible for the administration of SARA: the Minister of Fisheries and Oceans for aquatic species at risk, the Minister of Canadian Heritage for wildlife species in national parks, national historic sites, or other protected heritage areas, and, the Minister of the Environment for all other species at risk, and for administration of the Act (Bourdages, 2003).

For a marine species to be listed today it has to not only be recommended by COSEWIC for the list, but also needs ministerial approval (Boyd, 2003). COSEWIC bases its assessments solely on biological concerns (Prescott & Aniskowicz, 1992) while SARA takes into account the socioeconomic benefits and consequences of a listing (Bourdages, 2003). Upon the listing of a species under COSEWIC, a species status report and a recommended listing are passed on to the Ministers in charge of SARA. Before the federal government makes a final decision on the status of a recommended species, the species status report is given to stakeholders and posted on the Species at Risk Act public registry for public consultation (Bourdages & Labelle, 2003). For marine species, this includes consultations with fish harvesters and a potential examination of both available science and Local Ecological Knowledge (LEK) (SARA, 2009).

1.2. Current Listing Practices and the Inclusion of Local Ecological Knowledge

During the listing process there are two main areas where stakeholder knowledge, including Aboriginal Traditional Knowledge (ATK) and Local Ecological Knowledge (LEK), can be potentially taken into account: during the creation of species status reports in COSEWIC and during public and stakeholder consultations. To date, inclusion of local knowledge has been done mainly in conjunction with Aboriginal rights (Berkes, Colding,

& Folke, 2000; Nadasdy, 2003; Rusnak, 1997), and has involved either local communities or local members of a wildlife management board.

While there is no universally accepted definition of LEK, the working definition states that it contains empirical and conceptual aspects, is cumulative and dynamic over generations, and changes in response to socioeconomic, technological, and other factors (Berkes, et al., 2000). In the case of fish harvesters, it includes not only categories of fish, but also information on behaviour, annual cycles, winds, tides, and reference to spatial and temporal scales that may be different from those currently used by fisheries science (Neis, Schneider, et al., 1999).

For marine fishes and non-aboriginal fisheries, generally speaking, little heed is paid to LEK. There is no mechanism in place to support systematic collection of LEK or ATK as part of the listing deliberations and the information that is available is often anecdotal, consisting of comments at meetings or in discussions rather than the result of careful and systematic documentation of observations and worldviews (Berkes et al, 2000). This is particularly true of LEK, i.e. the knowledge of non-aboriginal commercial harvesters. As a result, the use of LEK in science and management more generally has been limited (Usher, 2000).

While marine fish have been evaluated since the beginning by COSEWIC, no fully marine Atlantic Canadian fish species has made it as far as legal protection under SARA through the full listing process put in place in 2003. Three species of wolffish, the Atlantic (*Anarhichas lupus*), Spotted (*A. minor*), and Northern (*A. denticulatus*), were grandfathered onto the list when SARA was implemented and thus did not undergo full review (SARA, 2009).

1.3. Wolffish Biology and the COSEWIC Listing

The three sympatric species of wolffish are found along the coast of Labrador and over the island, but are mainly found off of the Northeastern shelf and coast of Newfoundland, and on the shelf of the Grand Banks. There is little evidence of long migrations (Templeman, 1984). They have different niche requirements in their shared ranges, allowing them to co-exist in these habitats (Barsukov, 1972). *A. denticulatus* are less attached to the bottom, feeding on greater percentages of pelagic fish and lower percentages of benthic invertebrates than the other two species, and have the greatest range of depths, from 38 to 1500 m (Kulka, Simpson, & Hooper, 2004). *A. lupus* are the most southerly distributed species, found near shore to 900 m with concentrations at 150 to 350 m (Kulka, Hood, & Huntington, 2007). *A. minor* have the most restricted distribution, and reside in waters between 56 and 1000 m with concentrations between 200 and 750 m (Kulka, et al., 2007; Scott & Scott, 1988).

Wolffish have relatively low productivity based on growth, fecundity, and age characteristics, leaving them susceptible to abrupt overexploitation (Musick, 1999). Sperm and egg production is low, but fertilization is internal, and eggs and larvae are large. These factors, coupled with nesting habits and egg guarding behaviour of male wolffish (Keats, South, & Steele, 1985) increase the potential for survival of individuals during the early life stages.

There is no directed fishery for wolffish in Atlantic Canada; they are mainly caught as bycatch in many Atlantic commercial groundfish fisheries. Despite this lack of directed commercial exploitation, based on results from an analysis of DFO RV data, numbers of these large, slow-growing fish declined over 90% for all three species of wolffish in three generations between 1977 and 2001 (see Appendix A; Kulka, et al., 2007). As well, these assessments showed the number of locations where the species are found decreased over this period, showing a marked decrease in species range.

For these reasons wolffish were listed by the COSEWIC as Special Concern (*A. lupus*) in 2000 and Threatened (*A. minor* and *A. denticulatus*) in 2001. Apparent threats to wolffish include mortality as a result of bycatch, habitat alteration by bottom trawling, ocean dumping and pollution, perhaps compounded by environmental change (Kulka, et al., 2007).

1.4. Purpose of the Study

SARA is now fully implemented and has been effective since 2003 but the Species at Risk process continues to be controversial. The Minister has excluded most other marine species recommended by COSEWIC, such as the porbeagle shark and the northern cod, from listing under SARA to date due to social and economic considerations (Shelton, 2007). The three species of wolffish currently listed under the Species at Risk Act (SARA) are the only successful case of a listing of North Atlantic marine fish in Canada and so it is worth exploring the process and outcomes of the listing, different types of knowledge available on stock status, and their relationship, if any, to listing and to recovery strategies.

This is a multi-method study that uses an analysis of stock assessment data for the Northern Gulf of St. Lawrence supplemented by on-board observation and some semi-structured interviews with Northern Gulf fish harvesters to compare different sources of data on wolffish biology, biogeography, and population trends. It will document these harvesters' LEK and see whether there are ways it might be able to contribute or augment the scientific information available for evaluating stock status and for understanding harvester response to and engagement with the species at risk process. In addition it uses a review of existing documents and key informant interviews to understand how wolffish came to be listed, to capture the perspectives of a diverse set of stakeholders on the listing process, and on de-listing.

More specifically, the case study uses:

1. Stock assessment data and behavioural ecology data for the three wolffish species and related ecological indices to explore trends and patterns associated with these three species of wolffish for the Northern Gulf region.
2. On-board observations and semi-structured interviews with West coast (3Pn, 4RS) Newfoundland harvesters to explore harvesters' awareness, understanding and attitudes towards the listing as well as their LEK about catch rates, wolffish natural history, and wolffish distribution and abundance trends in the Northern Gulf.
3. Key informant interviews with scientists, managers and others involved with the listing and post-listing processes to explore how it began, how it unfolded, developments since the listing at the level of government and industry, the potential for de-listing, and the relevance of the wolffish case for future listings.

This research was carried out as part of the Community-University Research for Recovery Alliance (CURRA) project. CURRA is a 5-year research program of interdisciplinary research projects related to helping communities on Newfoundland's west coast develop strategies for the recovery of fish stocks and fishery communities. Two core partners in the CURRA include Intervale Associates and the Fish Food and Allied Workers Union (FFAW). Intervale Associates provides programs related to conservation, heritage interpretation, sustainable tourism, and rural development out of Codroy valley. The FFAW represents the workers of the fishing industry and are involved in the Sentinel project with DFO, which allows harvesters to work with scientists in stock assessment.

Project participants were asked to review and comment on a draft, plain-language report and relevant recommendations based on this research. The revised report and relevant recommendations was circulated to FFAW Union members in the study area and to other stakeholder groups, along with information on where to find the full report on the web

and a request for further input/discussion before posting and electronic distribution of the final report.

1.5. Outline of the Thesis

Chapter 2 of the thesis describes in detail the methods used for collection of harvester LEK through onboard observations and interviews, and presents results on wolffish life history, including morphology, habitat, diet, and seasonal distribution, and economic value. It makes a preliminary comparison of LEK with published science on wolffish in order to evaluate whether LEK can be used to help determine gaps in knowledge, help strengthen existing knowledge, or provide areas where knowledge should be re-examined. The comparison provides considerable detail, beyond what is possible in a publishable manuscript. In Chapter 3, harvester LEK of wolffish abundance and biogeography will be compared with results from the analysis of fisheries stock assessment data including sentinel mobile fishery and research vessel data through the East Coast of North America Strategic Assessment Project (ECNASAP). This comparison evaluates whether, in the case of wolffish, scientific studies and harvester LEK can be used conjointly to help assess and monitor species at risk. This chapter, which draws on Chapter 2, is written in the form of a manuscript suitable for publication. Chapter 4 draws on results from the key informant interviews, existing research on the SARA process, and elements of the LEK interviews dealing with the listing process to compare stakeholder opinions on the wolffish listing process and draws suggestions for future improvements to the listing process for marine fishes. Chapter 4 is written in the form of a manuscript suitable for publication. Chapter 5 summarizes what has been learned from each data source and identifies areas for future research.

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2. Collection and analysis of local ecological knowledge (LEK) through harvester interviews and onboard observations and consideration with published scientific data

2.1. Introduction

In Canada, there is a policy required to consider and include aboriginal knowledge into environmental assessments and into the Species at Risk Act (SARA) process (SARA, 2009). However, there are few cases where this policy has been implemented. While there are several examples of the utility of Local Ecological Knowledge (LEK) in fisheries (Huntington, 2000a; Lyver, 2002; Murray et al., 2008; Neis et al., 1997; Neis et al., 1999b) these tend to be contextual and small scale. Wider application of LEK remains elusive (Huntington, 2000b) and many fisheries managers still remain skeptical about the utility of LEK and Aboriginal knowledge (Usher, 2000).

A challenge in incorporating science and LEK is that all users of LEK must understand the strengths and weaknesses of both systems while holding no prejudices against either. Respect for the different types of knowledge systems along with rational skepticism are the best possible starting places (Davis and Ruddle, 2010; Lyver, 2002). However, even today, fishers' LEK is often labelled as anecdotal (Usher, 2000), and its use in science and management has been limited. In Canada there are virtually no established procedures on how to document, judge, incorporate, or implement LEK in any of the co-management bodies or endangered species agencies, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Rice, 2005). Due to insufficient understanding on the part of policy-makers of what LEK actually is, it is generally left up to individuals to decide how and when to implement this requirement (Usher, 2000). Rice (2005) found that the strongest way to include harvesters into science-based meetings was to invite individuals into the process and give them full participation rights.

The first step in a broad scale utilization of LEK in policy is the creation of a more transparent methodology for its collection. In many LEK studies there is a lack of information on the methodology used (Davis and Wagner, 2003), leaving future

researchers unable to duplicate the study. For LEK to be given equal consideration it must be documented in a rigorous way in order to evaluate whether it can be used to help determine gaps in knowledge, help strengthen existing knowledge, or provide areas where knowledge should be re-examined. This chapter will describe the methodology used to collect and analyze harvester LEK from the Northern Gulf of St. Lawrence and consider wolffish LEK, from interviews and onboard observation, and science on wolffish life history, including morphology, habitat, diet, and seasonal distribution, and economic value together.

2.2. Methods

2.2.1. Onboard Observation

A consent form, detailing the researchers involved with the project, the Community-University Research for Recovery Alliance (CURRA), community partners, the entire project goals, the confidentiality measures to be taken, the risks and benefits of the project, and consent, third party witness, and archival deposit forms was developed for this project (Appendix B). This form, a description of the proposed research, and the interview schedule were submitted to ICEHR, the Interdisciplinary Committee on Ethics in Human Research, at Memorial University and the research design was confirmed to be in compliance with the Tricouncil ethics policy.

Following ICEHR approval I contacted the Fish, Food, and Allied Workers (FFAW) Union to ask them for help in recruiting a sample of harvesters. The FFAW Union is a community partner of the CURRA. Members of the FFAW helped to identify 17 harvesters who fished American lobster (*Homarus americanus*) and six who fished Atlantic cod (*Gadus morhua*) from nine communities along the Northern Gulf of St. Lawrence (west and southwest coasts of Newfoundland; Figure 1). These harvesters were selected based on their involvement with the FFAW and their past histories of allowing researchers on board while they were fishing.

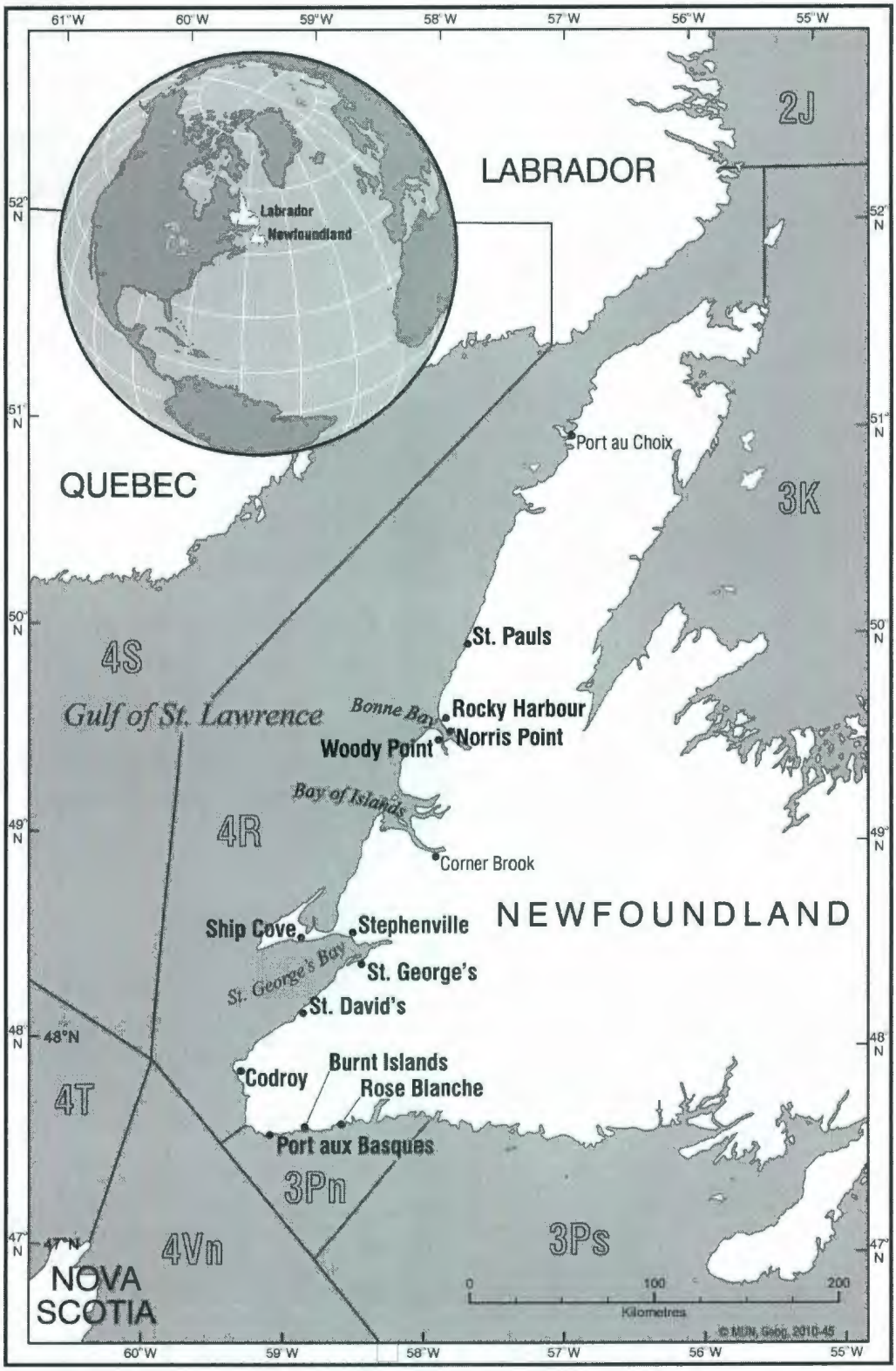

Figure 2.1: Map of the study area, which includes NAFO divisions 3Pn4R.

From May to June 2009, ten of the suggested American lobster harvesters were contacted by telephone. I explained to them who I was, what the project involved, and that I would be the only researcher on board. Five lobster harvesters agreed to take me on board for a day trip. During the first meeting with the harvesters the morning of the trip, I went over the consent form before asking them to sign. I explained that I was asking fish harvesters from the Northern Gulf of St. Lawrence to volunteer to let me accompany them on one or more fishing trips to record the location and composition of wolffish by-catch on their grounds and observe any problems harvesters might have dealing with this bycatch (risk of injury, etc.). The purpose of these observations was to supplement what I was learning from analyzing the research vessel surveys, fixed and mobile sentinel survey data on wolffish, and interviews with expert fish harvesters. Expert harvesters are defined in this study as individuals recommended by at least two sources (generally the FFAW and harvesters) and who had a minimum of 10 years of experience on the water. Harvesters were also asked for additional names of people who, in their opinion, would be good to interview. All additional names offered were already on the list of harvesters given by the FFAW; no new names came up. I explained that the list of harvesters participating in the research would be kept confidential and names or vessels would not be used in any presentations reports or publications resulting from this research. No harvester needed the third party witness consent form and all five harvesters agreed to participate and signed the consent form after reading through it. In the consent form, they were also offered the opportunity to review and comment on a draft final report and to receive a summary of the study findings. All five harvesters indicated their interest in doing this. On the archival deposit form harvesters described what they wanted done with notes once the research project was complete. They had the option of placing all pieces from their part in the research in the Memorial University Folklore Archive, to be accessed at the discretion of the Archivist, only with their own written permission, having the pieces retained by the research team, or having the pieces destroyed after completion of the project. All harvesters indicated that they wanted the documents deposited. They also had the option of receiving a copy of their notes sent to them, which none asked for.

I traveled with them to their grounds. Once there, harvesters went through their normal fishing procedures. When a wolffish was hauled up with the gear it would be kept on board for a few minutes so the GPS coordinates, species, length, and appearance could be recorded. Wolffish were identified by appearance and field marks (common identification marks for individual species) by myself. Depth was determined by onboard depth sounders or later, using GPS coordinates and mapping software. Notes were taken in a waterproof notebook to prevent loss of any information. During the trips, I asked the harvesters about any places where they used to see wolffish but no longer did, about variations they had observed in the distribution of wolffish on their grounds, and about when they were more and less likely to appear in their gear. Harvesters described past and present areas that were good for wolffish as they fished, as well as problems with hauling wolffish, all of which information was recorded. I also took notes on any conversations about wolffish for use as background to help me understand the information collected.

In August, I contacted four Atlantic cod harvesters. I explained: who I was; who my research assistant (who had joined me from the end of June to the end of August) was; what the project was about; what I would be doing on board; and I indicated that we both wished to go out on a trip with them. One harvester agreed to take us on board for a day trip but the other three could not due to time constraints. The consent and data collection processes here were the same as those outlined above for the lobster onboard observations.

Following each onboard observation session, all notes from that session were assigned a number and the master list of names, corresponding numbers, and contact information was stored in a separate, secure cabinet, away from the notes. My agreement with the harvesters was that the GPS coordinates of bycatch on the fishing grounds were to be kept confidential and only published in combination with coordinates collected from other harvesters to hide the location of their grounds. Only the information on wolffish location collected from each interview was to be used on its own. The information from the

onboard observation, including comments by harvesters, was coded into a series of finer categories and placed in a database.

2.2.2. Harvester Interviews

An interview consent form and schedule (Appendix C and D) were created for this portion of the project and submitted to ICEHR for approval. The application also included a phone script to be used when first contacting potential harvester interviewees. These were approved by ICEHR.

Once we had ethics approval, I asked the FFAW to help identify 30 harvesters from 13 communities along the Newfoundland west coast who were knowledgeable about wolffish. Of the list of 30 harvesters provided, I was able to contact twenty-five harvesters by telephone. I explained who I was, what the project involved, and that they had been identified as someone who was very knowledgeable about the fisheries in their area and who had a long history of involvement in those fisheries. I informed them that they were being contacted to see if they would be willing to do a face-to-face interview with me about those fisheries, and more specifically about their observations and experience with wolffish. I also indicated that I wanted to talk to them about the listing of wolffish under the Species at Risk Act and about their experience with and knowledge of any recovery programs that have been introduced. Finally, I indicated that I wanted to talk to them about any thoughts they might have about whether and how wolffish might be de-listed in the future and on the overall species at risk process. I told them the interview should take approximately one hour, but the length would depend on how much they had to say.

Twenty-one harvesters agreed to participate (the rest agreed and then became busy with fishing or meetings). When harvesters agreed, I arranged a date, time, and location to meet. For each interview there were two researchers present, myself and a student intern. Interviews were done one-on-one in a quiet area, often a person's house. When first

meeting the harvesters, we would review the consent form and ask them to sign if they were willing to participate. I explained that, with their consent, the interviews would be taped on a digital recorder and notes would be taken by the student intern. All harvesters agreed to be recorded during the interview. They were also asked to indicate what should happen to the information after the research was completed. All harvesters indicated that they wanted the documents deposited and released at the discretion of the archivist. They were asked if they would be interested in commenting on a draft final report for the study and would like to be invited to a feedback meeting in their area. They were also asked if they would like a copy of the final report sent to them. Thirteen indicated they would be interested in commenting on a draft final report, 20 were interested in attending a feedback meeting, and 13 asked for a copy of the final report.

During the signing of the consent form, the student intern set up the digital recorder with the interview number and date attached to the file and a touch screen laptop containing the appropriate digital or paper copies of Canadian Hydrographic services (CHS) charts[1]. After the consent and archival deposit forms were completed the interview started. The recorder was started and the date and interview number were recorded. Harvesters were told that they could ask for the recorder to be turned off during any part of the interview.

Harvesters were first asked demographic questions. Next, they were given an identification card created by Intervale Associates and Fisheries and Oceans Canada (DFO) (Appendix E) showing the three species and asked to identify which species they had seen, local names, relative numbers, and distinguishing features. Harvesters described wolffish species by appearance and from the cards identified the species correctly. Each card had scientific and common names on them, though all harvesters initially described the species using their own local names (generally 'catfish' for *A. lupus* and *A. minor*). Harvesters described wolffish by sight, as I did during the onboard observations. During RV surveys scientists also describe species by sight. Scientifically, the most reliable

[1] Charts were used with written permission from the CHS to copy charts for the purpose of this study. Unused copied charts were not given to harvesters and all unused copies were retained by the researcher.

biological way to readily differentiate wolffish in the lab is by their dentition, however this method is not practical onboard. Identification by field marks is not perfect, but the same method is used consistently through each method of study. This is further discussed in the morphology and species identification section.

Following identification we discussed their fishing history including species targeted, gear specifications, trends in catches, wolffish characteristics, and fishing ground characteristics. For this section, harvesters were asked if they preferred to use digital (n=15) or paper (n=6) copies of CHS charts. They then described the different fisheries that they had participated in at the beginning of their careers and more recently (end or recent seasons) and the related fishing grounds were recorded on the charts. Each marked area was assigned a number, and these numbers were listed on the chart and spoken into the recorder so we could connect chart objects to information in the transcript. Harvesters were asked to talk about wolffish biology, abundance, and distribution on their grounds. Towards the end of the interview harvesters were asked about their views concerning the listing of wolffish and their experiences with wolffish and with related conservation measures in their area since the listing[2].

After the interview, the digital recorder was stopped and the recording was saved on the recorder and as a computer file. All notes and charts used were numbered with the date, interview number, place, and interviewer initials. A copy of the consent form with contact names and information for the interviewers in case there were any further questions were left with the harvesters, along with a copy of the DFO wolffish identification card, and a

[2] The interview schedule was also designed to elicit some information for use by Kathleen Blanchard, our community partner, in a report for Intervale, *Evaluating Stewardship of Wolffish in Newfoundland and Labrador: Results from Dockside Dialogue with Fishers, 2004-2007*. Harvesters were asked where they thought the best places to film cod underwater in their areas might be located and if they recorded in their logbooks all wolffish catches as they were being brought up, off the water from memory, or only wolffish they brought in to the fish plant to sell.

DVD on wolffish stewardship produced by CURRA partner Intervale Associates as tokens of appreciation for their participation.

All interview recordings were transcribed following the interviews. During preliminary analysis of the transcripts, excerpts were broken down based on the following broad categories: demographics, fishing history, listing opinions, and conservation. The information in the interviews was coded into a series of finer categories and quotes were inserted into the relevant fields. This was placed in a database for organization. In the fishing history section of the database, numbers linked with areas on the charts were listed with the corresponding fishery and wolffish information from the transcript. Frequency of responses was analyzed.

2.3. Results

2.3.1. Onboard Observation

The five American lobster fishing trips took place between May 13th and June 16th, 2009. The number of years of fishing experience among these harvesters ranged from 13 to 32 years (mean = 24). Vessel size ranged from 18ft to 30ft. Pots were set the previous day, hauled up during the trip, then reset with new bait. Pots were baited with herring (*Clupea harengus)* and mackerel (*Scomber scombrus).*

The Atlantic cod fishing trip took place August 4th, 2009. The harvester had fished for 21 years and had a 30ft boat. The harvester had previously set his lines that morning, then had come back in to the dock to pick up me and my research assistant. No. 12 circle hooks were baited with mackerel (*Scomber scombrus)* and squid (*Illex* spp).

Table 2.1 summarizes observations collected during the six fishing trips, including the catch per unit effort (CPUE).

Table 2.1: Wolffish catches on the six onboard observation trips. (*lup* = *A. lupus*; *min* = *A. minor*; *dent* = *A. denticulatus)*

Area	Fishery	Date (2009)	Hours out	Depths fished (m)	Gear amount	Number of wolffish hauled	CPUE (per pot or hook)
Bonne Bay	Lobster	13 May	7	2 – 16	200 pots	-	-
St. David's	Lobster	18 May	5	5 – 32	200 pots	1 (*lup)*	0.005
Rose Blanche	Lobster	11 Jun	7	2 – 20	150 pots	-	-
St. George's	Lobster	15 Jun	10	1 – 20	400 pots	-	-
Ship Cove	Lobster	16 Jun	3	5 – 30	40 pots	7 (*lup)*	0.175
Port aux Basques	Atlantic cod	04 Aug	3	90 – 120	5 strings	15 (3 *lup*, 7 *min*, 5 *dent*)	0.0006 *lup*, 0.0014 *min*, 0.001 *dent*

Variability in catch per unit effort (CPUE) of *A. lupus* from the lobster and cod hauls ranged from 0 to 0.175 per pot/hook. The lobster fishery CPUE of wolffish in Ship Cove was between 5.8 and 291 times higher than the CPUE from both lobster and cod fisheries in all other areas. This was assumed to be a common catch from this harvester's knowledge of wolffish grounds. Other harvesters were not able to pinpoint the locations of probable wolffish hauls in either fishery. The depths of the catches in Ship Cove were normal for the Newfoundland lobster fishery (close to shore in relatively shallow waters).

The average lengths of *A. lupus* from the cod fishing trip were larger than those from the lobster fishing trips. This can be explained by the size restrictions associated with the design of the lobster pots. The portal for entry into the pot is created by using a ring size of between 4" ½ and 5." A portal this size would only allow mid-sized wolffish to enter, with large wolffish unable to get in. Smaller wolffish would be able to slip out of the pots due to their size. The average lengths of *A. minor* and *A. denticulatus* caught on the

longlines were much larger than those for *A. lupus*. These wolffish lengths will be compared with average lengths in survey data in chapter 3.

The hauls on the cod fishing trip included all three species of wolffish. In contrast, all harvesters on the lobster trips commented that the main wolffish species caught in lobster pots was *A. lupus,* with *A. minor* intercepted only occasionally. Only *A. lupus* was caught on the trips observed. In the three areas where no wolffish bycatch was observed, Bonne Bay, Rose Blanche, and St. George's, harvesters commented that there weren't a lot of wolffish in the area. The harvester from Bonne Bay commented that, while there weren't as many *A. lupus* caught in lobster pots now as in past years, numbers were still relatively high over the course of the season, with catches of one to two dozen a season. In Ship Cove, the harvester commented that the area had always been a good area for all species of wolffish, and during the trip he identified areas that had the strongest likelihood of catching wolffish based on past observations. He commented that wolffish bycatch numbers were up in the past several years for all wolffish species.

All harvesters including those who caught wolffish on the trip and those who didn't, said that wolffish in lobster pots will often eat any lobsters inside and that they would see the remains of lobsters (claws, tail, shell) inside when they hauled up the pot. The harvester from Ship Cove commented that he has found lobster remains left in pots but no wolffish left inside suggesting the wolffish escaped.

On the cod fishing trip the harvester commented that total catch sizes of a dozen wolffish (composed of all three species) a day were common in recent years. He said that catch sizes had increased over the past few years of all three species.

Wolffish Handling and Related Discussions

Harvesters removed wolffish caught in lobster pots by first removing any lobsters and other fish species from the pots, and then placing their hands behind the head and slightly

in the gills and lifting them out of the pot chamber. Wolffish were removed from longlines by placing a gaff in their mouths when they were on deck and twisting the hook out, releasing them safely. During onboard observation, after release from the gear, the wolffish were placed on the vessel deck for observation by the researcher. Only three fish, all *A. denticulatus*, were too large to be hauled onboard and these were observed on the side of the vessel while still in the gear. Species, length, and appearance were recorded, as well as the GPS coordinates from the catch site. After these were recorded the harvesters picked up the wolffish by the back of the head and tossed them back into the water. Locations were geo-referenced after returning to shore.

During onboard conversations all lobster harvesters noted that wolffish are easy to get out of lobster pots. Harvesters could take them out by hand (as was done on the trips to get them onboard to observe) or they could turn the pot over at the side of the vessel and the wolffish would drop out. The cod-fishing harvester noted it was easy to get wolffish off the longline hooks with a gaff. He didn't, however, like seeing them in his gear because of gear damage. Large wolffish are known to break the lines when being hauled up, taking the hooks with them.

The average length for *A. lupus*, from both the lobster and cod fishing trips, was 0.88 m (Appendix F); the average lengths of *A. minor* and *A. denticulatus* (cod fishing trip) were 1.45 m and 1.65 m, respectively.

On the lobster trips the depths of lobster pots with wolffish in them ranged from 5 to 20 m (average = 12 m). The depths that intercepted wolffish on the cod trip ranged from 92 to 108 m.

2.3.2. Harvester Interviews

The 21 harvesters who participated in the wolffish interviews had fished between 13 and 39 years (mean = 28). They described on average 3.6 fisheries they had participated in

and were generally skippers of their own boats (n=18) (Appendix G). The shortest interview ran 23 minutes while the longest ran 1.06 hours (mean = 43 ± 12 mins). The length of the interview depended on the number of years they had been catching wolffish, the size of their catches, the number of fisheries they participated in, and the extent of the discussion evoked by the questions.

Harvesters described their wolffish bycatches in Atlantic cod (*Gadus morhua*) (19 of 21 harvesters), American lobster (*Homarus americanus)* (20), snow crab (*Chionoecetes opilio*) (11), halibut (*Hippoglossus hippoglossus)* (10), lumpfish (*Cyclopterus lumpus*) (10), winter flounder (*Pseudopleuronectes americanus)* (2), commercial bait fish (capelin (*Mallotus villosus)*, herring (*Clupea harengus)*, mackerel (*Scomber scombrus*) (1), grey sole (*Glyptocephalus cynoglossus)* (1), and salmon (*Salmo salar)* (1) fisheries. Several harvesters (n=5) were involved in DFO's groundfish sentinel program for both fixed (n=4) and mobile gear (n=2) and their observations during sentinel fisheries were also discussed.

Gear types used by harvesters in all fisheries included longline (J and circle hooks), lobster pots, gillnets (lumpfish 10 – 10 ½" to 11-11 ½" mesh; cod 5 ½ - 6" mesh; other groundfish 7" mesh), Danish seines, and crab pots. Depths fished ranged from 2 m (with lobster pots) to 1200 m (with crab pots and longlines) (Figure 2). Months on the water ranged from April to November, with a winter cod fishery in the past and some in 3Pn still fishing cod in the winter (December to March).

When asked to identify wolffish species they had hauled up in their fisheries, 21 harvesters reported catches containing *A. lupus* and *A. minor* in Atlantic cod, lobster, lumpfish, halibut, winter flounder, grey sole, and snow crab fisheries during the past and present summer fishing season (April to September) and, where applicable, the past winter season (November to January-February). Sixteen reported catches of *A. denticulatus* from Atlantic cod, halibut, and snow crab fisheries during the past and present summer fishing season and past winter season.

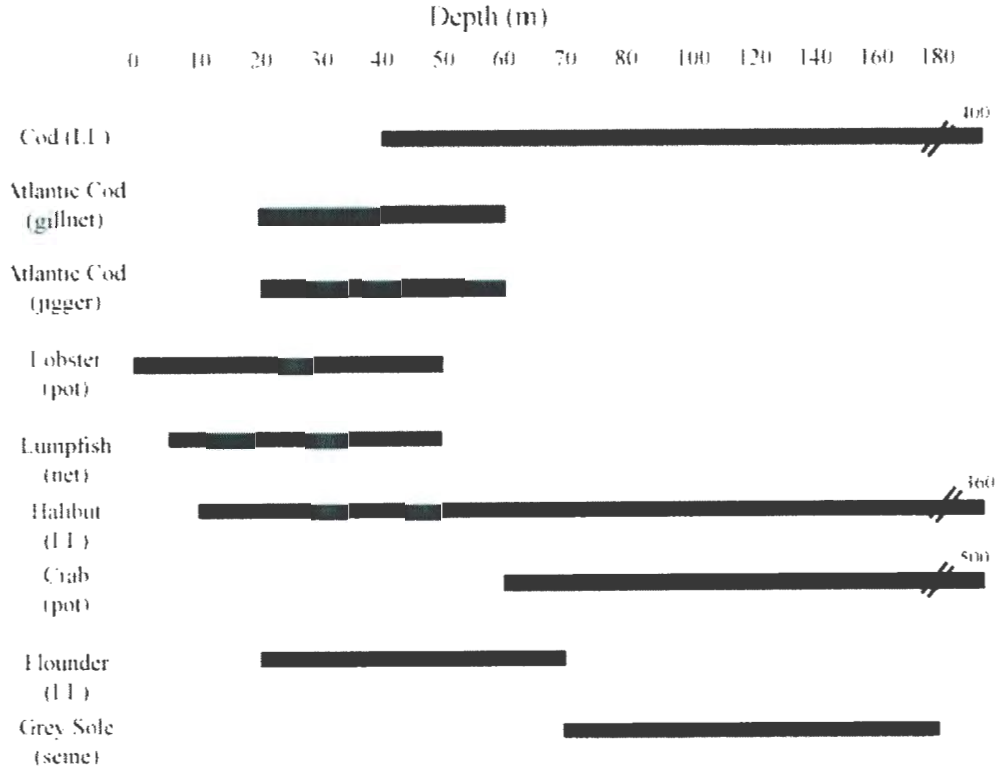

Figure 2.2: Depth ranges for common fisheries in the Northern Gulf. LL = longline.

2.3.3. Life History

Morphology

All harvesters presented with the wolffish identification sheet recognized the species right away and they appeared to have no problem distinguishing between them. Twenty one harvesters reported seeing both *A. lupus* and *A. minor*, while 16 also reported seeing *A. denticulatus*. *A. lupus* were commonly called striped catfish, catfish, blue striped and Boston bluefish; *A. minor* were commonly called catfish; *A. denticulatus* were called wolffish, or jellycats. All harvesters from all communities used the name catfish for both *A. lupus* and *A. minor*; the name wolffish was used by all harvesters for *A. denticulatus,* and by 16 harvesters for *A. lupus* and *A. minor*.

Harvesters were asked to describe the appearance of the wolffish in their catches. Twelve harvesters (n=12) reported that *A. lupus* were characterized by their solid colouration and, often, their small sizes. Sometimes they were described as having darker colouration when hauled with blue, grey, brown, or green being reported. Two harvesters indicated that on some *A. Lupus*, the body stripes weren't visible (n=2). *A. minor* were described as dark aqua in colour with spots (n=13). *A. denticulatus* were reported to be a purple colour with a pink belly when hauled up (n=8).

Habitat

When asked about what bottom type they would most often find wolffish on, harvesters from all areas reported that they were most often found in rocky habitats (n=13) in both the cod and lobster fisheries (Appendix H). It was thought that wolffish go to rocky bottoms to find shelter between large boulders.

> **H**: When they are not forging, they are just sheltering, they always seem to try and get under a shelter of a rock. When breeding season comes on they will actually excavate in large holes under boulders. (Harvester interview #10)

Harvesters in all areas reported *A. lupus* were most often caught in lobster pots on rocky bottoms (n=10) and on sand (n=5); they were also caught in Bonne Bay and Bay St. George in shallow areas with kelp beds (n=3).

> **Q:** Would you get all three species on your lines?
> **H:** No, mostly the striped ones [*A. lupus*]. Some days you might set in here or over there. There could be a big difference in the catfish you see. Depends on what bottom you set on.
> **Q:** What bottom tends to be better for catching striped?
> **H**: Here it is all sand and gravel. But we get them in on the hard bottom too on our lobster traps and that is right in the rocks when we get them in our lobster pots. (Harvester interview #19)

Some harvesters said *A. minor* was caught on muddy (n=5) or sandy (n=9) bottoms. Three harvesters commented that *A. denticulatus* were found on what were described as clean bottoms with sand and clay; the other 13 harvesters who reported *A. denticulatus* in their catches did not know or comment on what bottom type the species frequented.

A. lupus were found close to shore, while both *A. minor* and *A. denticulatus* were found in deeper waters (>40m).

Diet

When asked if they had seen wolffish eating in their gear, harvesters primarily discussed observations from the lobster fishery. In the pots they had seen both *A. lupus* and *A. minor* eating bait fish (herring, mackerel, squid) (n=10) and American lobster (*Homarus americanus*) (n=14). Bait fish were the most cited reason why all three species of wolffish entered their gears; harvesters commented that in the lobster, cod, halibut, snow crab, and winter flounder fisheries they had commonly seen wolffish entering the pots or getting caught on the hooks when going after bait fish (herring, mackerel, squid) (n=13). As the quote below indicates, in the case of the lobster fishery it was hard to tell whether the wolffish were attracted to the pot by the bait or the lobster inside.

Q: Do they go after the bait [in the lobster pots]?
H: I don't know, when you haul up the pots they are back in the part with the lobster. When you see a wolffish in a lobster [pot], you can always count on one or two lobsters dead. Tails chewed off. They bite the tails and sucks the meat out. (Harvester interview #21).

Harvesters reported hauling lobster pots that contained wolffish but no lobster, indicating that they were going after the bait. Harvesters also reported seeing *A. lupus* eating sea urchins (*Strongylocentrotus droebachiensis) (n=9)*, blue mussels (*Mytilus edulis) (n=1)*, and dog whelks (*Thais lapillus*) (n=1) in lobster pots.

Harvesters fishing longlines reported seeing larger *A. minor* and *A. denticulatus* with Atlantic cod (*Gadus morhua*) and winter flounder (*Pseudopleuronectes americanus)* in their mouths in the cod and halibut fisheries.

In the past, when cleaning wolffish (species) for sale, harvesters reported that they had seen mostly shellfish in the guts of *A. lupus* and *A. minor,* with few fish. They reported seeing remains of snow crabs (*Chionoecetes opilio) (n=4)* , blue mussels (*Mytilus edulis) (n=1)*, sea scallops (*Placopecten magellanicus*) (n=2), sand dollars (*Echinarachnius parma*) (n=1), dog whelks (*Thais lapillus*) (n=1), American lobster (*Homarus americanus*) (n=14), rocks (n=2), coral fragments (n=2), and lumpfish (*Cyclopterus lumpus)* roe (n=2) in their stomachs. They did not distinguish in their observations between the diets of *A. lupus* and *A. minor*.

Seasonal Distributions

When asked when in their fishing season they had seen wolffish, harvesters reported that wolffish weren't seen consistently throughout their fisheries. Ten harvesters reported that the depths associated with wolffish catches changed over the season.

In all areas, catches of *A. lupus* were found in lobster pots in shallow waters throughout the spring and these catches continued as the harvesters moved their lobster pots further

inshore from May to June. In Bonne Bay harvesters reported that the largest catches occurred in the spring (April) in the lobster pots. However in all other areas catches were largest later in the lobster season, in June (Appendix I).

> **H**: The early part of the season you don't get no catfish at all....it seems then a little later in the season you start picking up some.
> (Harvester interview #10 – Bonne Bay)

In the cod fishery, from Rose Blanche to Port aux Basques and in the Bay of Islands, the largest catches of *A. lupus* were seen at the beginning of the season (June) and tapered off during July and August.

A. minor catches were reported at the beginning of the season (June) from Rose Blanche to the Port aux Basques area and in the Bay of Islands area in lobster pots. The largest *A. minor* were reported in Bay St. George halibut and snow crab fisheries later in the season (August), with numbers dwindling into the fall (September). In lobster pots from Codroy to St. David's *A. minor*, like *A. lupus*, were found towards the end of the season in June.

For all three species all harvesters reported that large adult *A. denticulatus* were reported in cod longline gear early in the summer (June) from Rose Blanche to Port aux Basques and Bay of Islands in both the past and present fisheries. They were reported much later in the season and were larger in the cod fishery in Bay St. George. Harvesters did not report any changes in observed distributions for any of the species.

2.3.4. Economic Value

When asked if wolffish had any value to them and if there was a market for the wolffish they caught, pre- and post-listing, 13 harvesters reported keeping and selling *A. lupus* and *A. minor* before the listing, five reported releasing them alive. They said that catch rates in the past were too low for a targeted wolffish fishery. The ones that were marketed were brought up as bycatch in the Atlantic cod, halibut, and winter flounder fisheries.

> **Q:** You would sell striped and spotted with the cod catch?
> **H:** You would sell [wolffish] when you could get a price for them. There was always a lot of them. (Harvester interview #18)

When asked if there was a market for wolffish in their area over the last few seasons they had fished, only eight harvesters reported keeping *A. lupus* for sale since the listing; 11 reported throwing all species back alive. The 12 harvesters who had caught *A. denticulatus* did not consider them to be marketable because consumers don't want the jelly-like meat.

> **H**: Yeah. I mean one time you could sell them if you caught 'em you could bring 'em in. You never got much for them, but I mean you got something.
> **Q**: Which ones would you normally sell?
> **H**: Both spotted [*A. minor*] and stripped [*A. lupus*] ... I've never have seen too much of the northern [*A. denticulatus*]. I don't think they'd want them cause they was jelly. (Harvester interview #15)

Harvesters were also asked about the average landings and sales in their area; harvesters reported that landings had never been large in any area. Harvesters reported selling wolffish for prices varying from $0.01 to $0.25/pound.

2.4. Discussion

In this section I will be considering LEK findings with findings in published science and discussing where they agree and differ, and why. In the literature there have been several past studies that have focused on wolffish biology, abundance, and biogeography. More recent literature has been focused away from these topics. In the last two decades the trend in wolffish published scientific literature has been towards molecular biology and aquaculture. This trend originated in Northern European waters, in Norway, Iceland, and the Russian Federation, and has spread to Canada and the USA. Both *A. lupus* and *A. minor* have been used in aquaculture in these areas for their meat and leather. While this new knowledge has increased our understand of wolffish biology and in the lab, there are

still several gaps in knowledge of wolffish biogeography and populations in the wild, both of which is highly important from a species at risk legislative point of view.

Life History

Morphology and Species Identification

While harvesters described the wolffish species by appearance from the identification cards correctly, scientifically, the most reliable biological way to readily differentiate wolffish in the lab is by their dentition. Species identification in the field, however, must be done by field marks. In ornithology, field marks are routinely used in place of the morphological traits used in museum collections. In ichthyology, while it is assumed that field marks can be used, there has been little to no work done to measure their reliability. Studies have been done to show methodological errors and biases associated with visual counts by SCUBA divers (Harvey et al., 2002; Mapstone and Fowler, 1988), but there is no mention of biases or error in species identification in the field. The reliability of identification by local users such as fish harvesters is not known from scientific literature.

In the case of wolffish it is hard to consistently differentiate individual species by sight; all three species have heavy blunt heads with large jaws and stout bodies (Scott and Scott, 1988). *A. lupus* and *A. minor* are extremely similar in body form and colouration (Barsukov, 1972) introducing biases in identification. Reported colouration may not always be reliable for definitive species identification. There is a noticeable protective nature to all wolffish colouration. In the scientific literature all species are characterized by grey and brown tones, adapted for camouflage on the bottom. Intensity of colouration increases with age. The differences in the blue, aqua, and purple colouration reported by harvesters in Newfoundland waters and the duller colour from scientific studies in northeastern waters may be a result of differences in habitat or depths caught; however the scientific studies gave neither area, bottom type, or depth to wolffish caught for colouration analysis, making it hard to examine. Wolffish caught in shallower waters may be lighter due to the great intensity of light exposure closer to shore.

There have been many recorded *A. lupus* x *A. minor* hybrids (Gaudreau et al., 2009). *A. lupus* and *A. minor* are long and elongate, differing in body colouration. They differ visibly in body shape from *A. denticulatus*; *A. denticulatus* bodies are heavy and thick-set, with a slightly convex lower profile, making adults distinguishable from the other two species (Scott and Scott, 1988). There have been *A. minor* x *A. denticulatus* spotted hybrids recorded (Templeman, 1986).

Regardless of this both harvesters and scientists rely on visual identification to differentiate wolffish species; this was used during the onboard observations as well. This method is considered to be reliable when wolffish size, colouration, and body form are all taken into account.

Habitat

Both harvester reports and scientific literature showed that *A. lupus* is the most common wolffish caught in fisheries as bycatch. In the case of harvesters, *A. lupus* are predominately caught in inshore fisheries, showing that inshore gears preferentially catch *A. lupus* or that they are found in shallow waters more commonly than the other two species. This is consistent with scientific data, which shows depth ranges of *A. lupus* closer to shore than both *A. denticulatus* and *A. minor*.

In general harvesters were more likely to be able to identify bottom habitats frequented by *A. lupus* than for the other two species due to the shallow depths. Harvesters predominantly reported *A. lupus* in rocky habitats close to shore, a fact that is also reported in science literature. In northeastern Atlantic waters (Norway, Iceland, Russia) *A. lupus* is reported to be a coastal species that prefers stony bottom (Barsukov, 1972). Scientific studies in Newfoundland (Kulka et al., 2007) show that they are most often caught in rocky bottoms (followed by gravelly sand and shell hash). *A. lupus* that were reported in shallow kelp beds can be explained by increased feeding on the echinoderms and crustaceans that inhabit the beds, or from wolffish using the kelp as camouflage. The

kelp beds were surrounded by rocky habitat, making them the ideal place to relocate quickly for food or shelter.

The findings in the scientific literature for *A. minor* differ slightly from the reported observations in the Newfoundland harvester reports. *A. minor* has been found from mud, clay, and sand with clay areas, to rocky bottoms (Barsukov, 1972) in northern European waters. Studies in Newfoundland show that they are most often caught on sand and shell hash, which is consistent with harvester reports for the Northern Gulf of St. Lawrence. A few *A. minor* have been caught on mud in Newfoundland (Kulka et al., 2007). The slight differences between Newfoundland and Northern European waters can may be due to differing habitats and wolffish adaptations.

Attachment of wolffish to hard bottom has been shown to decrease at greater depths in northern European waters (Barsukov, 1972). This explains why few reports in science and none by harvesters described *A. denticulatus* caught in this common habitat. Out of all three species *A. denticulatus* is the least attached to the ocean floor, spending more time in the water column (Kulka et al., 2007). The few studies linking catches to bottom type in Newfoundland have shown, however, in depths of 500-1000m there is a preference for sand and shell hash, which agrees with harvester reports.

Diet

Similarity between different species in respect to feeding has been observed more often than differences. The majority of wolffish diet studies rely on lower gut sampling. Harvesters reported that wolffish live mainly on hard-shelled organisms. Similar findings are reported in the scientific literature where research has shown that the most common diet for all three species includes molluscs, echinoderms, and crustaceans, which they tear and crush with specialized teeth (Albikovskaya, 1983). Fragments of mollusc, crustacean, and echinoderm shells have been found in the intestines of wolffish (Barsukov, 1972).

Wolffish do, however, show opportunistic feeding patters (Falk-Petersen et al., 2010). McRuer *et al.* (2000) noted the occasional redfish in the diet of *A. lupus* and *A. minor*. In Norway wolffish were found to prey on capelin, Norway pout, and redfish fry, though they were of little importance in the overall diet (Falk-Petersen et al., 2010; Jaworski and Ragnarsson, 2006). These scientific findings lend some support to fisher beliefs that wolffish sometimes target bait in their traps and on their longlines. Wolffish may be taking these species, along with lobster and snow crab, due to proximity and ease of catching.

Seasonal Distributions

There are few published findings on wolffish seasonal distributions. Though there is evidence of seasonal inshore-offshore wolffish migrations of *A. lupus* in Icelandic waters (which are assumed to exist for other species and areas of wolffish concentration), migration patterns are poorly understood (Templeman, 1984). Harvesters reported that *A. lupus* and *A. minor* moved inshore as water warmed in the summer. Kohler (1968) reported that inshore migrations of *A. lupus* have been noted in Nova Scotia during May and June. The largest reported catches in the lobster fishery (the closest fishery to shore) in the LEK interviews occurred at the end of the season in June. One theory is that wolffish move closer to shore as summer progresses in preparation for fall spawning (Keats et al., 1985; Kohler, 1986).

Harvesters reported that numbers of all species observed in their gear dwindled in the fall. During this time (September and October) in Newfoundland, *A. lupus* reproduce, depositing egg masses (Keats et al., 1985; Kohler, 1986). Male and female wolffish pair up in caves and lay their egg bundles. During this time neither sex forages for food. Females then leave the cave and males spend the next several weeks to a month (Scott and Scott, 1988) caring for the eggs until they hatch. It is not known where the females go. During this time harvesters reported that they did not see wolffish in their gear, that they 'seem to disappear.'

Economic Value

The market value reported by harvesters on the Northern Gulf of St. Lawrence matches the values for the rest of the island. *A. lupus* and *A. minor* are the only wolffish registered as landings by DFO. The majority of these landings are from the cod (46%), yellowtail flounder (11%), and unspecified fisheries (29%).

NAFO subdivisions 3Pn and 4R are responsible for 17% and 20%, respectively, of total value from wolffish catches in Newfoundland. The sale prices for wolffish decreased dramatically from 1995 to 2002, from $2.21 to $0.42/pound. Recent years has shown prices for *A. lupus* still very low. These recent low prices would explain why only eight harvesters still keep and sell *A. lupus* (other two species are tossed back alive) and most disagree on the price per pound that they can get. If very few harvesters are selling their wolffish catches today and would get little for them they may be less likely to remember their average catch sizes each year.

Landings are further discussed in chapter 3.

2.5. Conclusion

Results of analysis of the two types of data in this chapter show, in the case of wolffish, there is concurrence on several aspects with no inconsistencies and a degree of complementarity. In the case of wolffish, scientific studies and LEK can be used conjointly given these three criteria. In Newfoundland stock assessment has traditionally been concentrated in offshore waters, rarely venturing into bays and shallow waters. As a result, in many places harvester knowledge is the only source of data on trends over time in inshore waters (Neis et al., 1997), giving it an important role to play in fisheries assessments. When science, in the form of stock assessment or published scientific studies, and LEK agree, uncertainty is reduced and assessments become more convincing

to resource users (Neis et al., 1999a). When information diverges both sides need to be re-examined, however, many scientists do not use this criteria.

For LEK to be presented and judged in comparable terms with science it must have a transparent and reproducible methodology, like the one described in this chapter. The collection of LEK for consideration with published science to determine any gaps or differences, is an important stepping stone towards the application of LEK for management and species at risk purposes, as examined in chapter 3.

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3. Integrating fishers' knowledge from the Northern Gulf of St. Lawrence with the science of three species of wolffish listed under the Canadian Species at Risk Act

3.1. Abstract

Three sympatric species of wolffish, the Atlantic (*Anarhichas lupus*), spotted (*A. minor*), and northern (*A. denticulatus*), are currently listed under the Canadian Species at Risk Act, based on limited scientific data from a relatively short time series of offshore scientific trawl survey data. Results from Local Ecological Knowledge (LEK) interviews with experienced fish harvesters along Newfoundland's west coast documenting wolffish trends in abundance and biogeography were considered with fisheries stock assessment data from research vessel cruises. Analysis of data from harvester interviews and onboard observation conducted in 2009, and stock assessment data showed that wolffish have always been relatively rare in the Northern Gulf of St. Lawrence as a whole but one species is quite abundant in some areas. Though declining catch rates in 4R meet criteria for the listings, harvesters described no change (n=7) or higher (n=12) relative catch rates for *A. lupus* over their careers (mean = 28 years). ECNASAP data for 4R showed no significant decline in catch rates. Onboard observations and interviews reported higher annual variability in catches, ranging up to 80 wolffish a day on Atlantic cod longlines but often 0, than stock assessment averages reported. Harvesters did not report any consistent way of avoiding large catches; there were no consistent predictors of catch sizes from stock assessment maps. Wolffish sizes seen onboard and described by harvesters indicated adults (>55cm) are predominately being caught in inshore fisheries. Sentinel mobile data shows an *A. lupus* juvenile:adult ratio of 9.8:1 (n=1940), indicating offshore maturing of juvenile wolffish and a later migration inshore, possibly for reproduction.

3.2. Introduction

In the last decade there has been an increased focus on assessing the risk status of species on local, national, and global scales. Many countries, including Canada and the United States, as well as the European Union, have legislation in place to help not only assess species, but in many cases to protect those species most at risk of extirpation or extinction.

On the International Union for the Conservation of Nature (IUCN) Red List, out of the estimated 31,300 species of fishes described from 1996-2010 (January), only 14% have been assessed (IUCN, 2010). Approximately 32% of those fishes assessed are threatened, the highest percent of all vertebrates. Recent research has shown that many fish stocks have been fished to the brink of commercial extinction; an even greater number of non-commercial species are disappearing from the world due to elimination of habitat and as bycatch in large fisheries and (Dulvy et al., 2005).

While listing decisions are primarily based on fisheries science, there is a lack of scientific data for many marine species. This is reflected in the large number of species assessed by the Committee on the Status of Endangered Species in Canada (COSEWIC) in Canada as at risk. In Canada, since the introduction of the Species at Risk Act in 2003, before the federal government makes a decision on the status of a recommended species, the species status report, completed by COSEWIC, is given to stakeholders and posted on the Species at Risk Act public registry for public consultation (Bourdages and Labelle, 2003). For marine species, this includes consultations with fish harvesters and a potential examination of both available science and Local Ecological Knowledge (LEK) (SARA, 2009).

To date, inclusion of local knowledge (often called Aboriginal Traditional Knowledge - ATK) and results from local consultations has been done mainly in conjunction with listings in areas where Aboriginal people retain rights (Rusnak, 1997, Berkes et al., 2000,

Nadasdy, 2003), and has primarily involved local members of a community group. For marine fishes and non-aboriginal commercial fisheries, generally speaking, little heed is paid to local harvester knowledge. There is no mechanism in place to support systematic, ongoing collection of LEK as part of the listing deliberations and it is therefore often labelled as 'anecdotal' (Sáenz-Arroyo et al., 2005). Its use in science and management more generally has also been limited (Usher, 2000).

Current Listing Practices, Science, and Local Ecological Knowledge

For a marine species to be listed today it has to not only be recommended by COSEWIC for the list, but this recommendation also needs ministerial approval (Boyd, 2003). Before the government makes a decision on the status of the recommended species, the status report is distributed to stakeholders and posted on the SARA public registry for public consultation.

During the listing process there are two main areas where stakeholder knowledge, including ATK and LEK can be potentially taken into account: during the creation of COSEWIC species status reports and in SARA-related public and stakeholder consultations. The most common inclusion of local knowledge takes place where Aboriginal land claims exist. In these cases the Minister will consult the Wildlife Management Board (if formed) and those Aboriginal peoples affected (Rusnak, 1997).

Research on artisanal and commercial fishermen's LEK began to appear in the fisheries literature in the late 1970s (Johannes, 1992, Neis et al., 1999a, Berkes et al., 2000). While there is no universally accepted definition of LEK, the working definition states that it contains empirical and conceptual aspects, is cumulative and dynamic over generations, and changes in response to socioeconomic, technological, and other factors (Berkes et al., 2000). In the case of fish harvesters, it can include not only categories of fish, but also information on behaviour, annual cycles, winds, tides, and reference to species abundance and distribution, as well as fishing activity at spatial and temporal scales that may be

different from those currently used by fisheries science (Neis et al., 1999a, Vodden et al., 2005). Fishers relate to special places or grounds to maximize their economic use of the sea. This is related to the ecological characteristics of a fishing ground, for instance areas of high fish abundance; social aspects can also influence these decisions (Maurstad, 2002).

LEK has an empirical basis and is used by holders to understand and, in some cases, predict environmental events (Huntington, 2000). Not all fishers have equal amounts of LEK. Most LEK tends to be spatially narrow, restricted to grounds fished, but can include received information from fishers elsewhere and insights from science presented in meetings or on the radio. Knowledge is bounded by legal or customary property rights and by harvesting periods (Usher, 2000) and varies across gear sectors and in larger vessels, between skippers and crew. While they may have knowledge of other grounds and other fisheries (some know of good sites without using them themselves), generally it is assumed that fishers keep secrets from one another, especially in fisheries where they move their gear from day to day or week to week (Maurstad, 2002).

Aboriginal and harvester knowledge and fisheries science often differ on both temporal and spatial scales (Murray et al., 2008a, Neis et al., 1999b). Historically, research vessel (RV) data have been taken from primarily deeper, often offshore waters at fixed and very constrained times of the year. LEK, in contrast, works on a smaller spatial scale; it tends to be based on fishing in shallower, coastal, areas (for small scale fishers); can have incorporated into it for older fishers, observations covering a longer temporal scale than is available through science, with more intensive sampling due to their substantial time on the water (Fischer, 2000). Fisheries science is designed to permit generalization from sampled areas to the larger area under investigation. It is often more difficult to generalize from information contained in LEK based on particular areas to other areas (Murray et al., 2008b).

While marine fish have been evaluated since the beginning by COSEWIC, no fully marine Atlantic Canadian fish species recommended for listing by COSEWIC has made it through the full listing process put in place in 2003 to the point of legal protection under SARA. Three species of wolffish, the Atlantic (*Anarhichas lupus*), Spotted (*A. minor*), and Northern (*A. denticulatus*), were grandfathered onto the list when SARA was implemented and so did not undergo a full review (SARA, 2009).

The listing decision for the three species of wolffish was based on limited scientific data from a relatively short time series of offshore scientific trawl survey data. In this study, results from LEK interviews with experienced fish harvesters along Newfoundland's west coast documenting harvesters' knowledge of wolffish trends in abundance and biogeography were considered with fisheries data from research vessel cruises and Sentinel fisheries to reconstruct trends (pre- and post-listing) and distribution of wolffish in part of the Northern Gulf of St. Lawrence (4R).

The Biology of Wolffish

The three sympatric species of wolffish are found along the coast of Labrador and over the island, but are mainly found off of the Northeastern shelf and coast of Newfoundland, and on the shelf of the Grand Banks. There is little evidence of long migrations (Templeman, 1984). They have different niche requirements in their shared ranges, allowing them to co-exist in these habitats (Barsukov, 1972). *A. denticulatus* are less attached to the bottom, feeding on greater percentages of pelagic fish and lower percentages of benthic invertebrates than the other two species, and have the greatest range of depths, from 38 to 1500 m (Kulka et al., 2004). *A. lupus* are the most southerly distributed species, found near shore to 900 m with concentrations at 150 to 350 m (Kulka et al., 2007). *A. minor* have the most restricted distribution, and reside in waters between 56 and 1000 m with concentrations between 200 and 750 m (Kulka et al., 2007; Scott and Scott, 1988).

Wolffish have relatively low productivity based on growth, fecundity, and age characteristics, leaving them susceptible to abrupt overexploitation (Musick, 1999). Sperm and egg production is low, but fertilization is internal, and eggs and larvae are large. These factors, coupled with nesting habits and egg guarding behaviour of male wolffish (Keats et al., 1985) increase the potential for survival of individuals during the early life stages.

There is no directed fishery for wolffish in Atlantic Canada; they are mainly caught as bycatch in many Atlantic commercial groundfish fisheries. Despite this lack of directed commercial exploitation, based on results from an analysis of DFO RV data, numbers of these large, slow-growing fish declined over 90% for all three species in three generations, between 1983 and 1994 (Kulka et al., 2007). As well, these assessments showed the number of locations where the species are found decreased over this period, indicating a marked contraction in species range.

For these reasons wolffish were listed by COSEWIC as Special Concern (*A. lupus*) in 2000 and Threatened (*A. minor* and *A. denticulatus*) in 2001. Apparent threats to wolffish include mortality as a result of bycatch, habitat alteration by bottom trawling, ocean dumping and pollution, perhaps compounded by environmental change (Kulka et al., 2007).

Objectives of the Study

This study compared harvester LEK from a portion of the Northern Gulf of St. Lawrence (area 4R) related to wolffish biology, abundance, and biogeography with results from an analysis of fisheries stock assessment data including data from a Sentinel mobile fishery, conducted in the Northern Gulf between the Strait of Belle Isle and Burgeo on Newfoundland's south coast from 1999 to 2008, and research vessel survey data for the years 1970 to 1994 assembled through the East Coast of North America Strategic Assessment Project (ECNASAP). This comparison is used to examine whether, in the

case of wolffish, scientific studies and harvester LEK can be used conjointly to help improve the assessments and monitoring of these species at risk.

3.3. Methods

3.3.1. Onboard observation

From May to June, 2009 five lobster harvesters (out of the ten contacted) agreed to take me on board for an observation day trip along the west coast of Newfoundland (Figure 3.1). In August, one additional cod harvester (out of the four contacted) agreed to take myself and another student onboard. These harvesters were indentified by a representative of the Fish, Food, and Allied Workers (FFAW) union based on their past involvement with the union and on their history of allowing researchers on board while they were fishing. On both the lobster and cod fishing vessels observations of normal fishing practices were made, and, with each haul that contained wolffish bycatch, the GPS coordinates, species, length, and appearance were recorded. Wolffish were identified by the researcher based on appearance and field marks (common identification marks for individual species). Depth was determined by onboard depth sounders or, some cases, using a combination of GPS coordinates and mapping software after the trip was finished.

Following each onboard observation session, all notes from that session were assigned a number. The master list of names, corresponding numbers, and contact information was stored in a separate, secure cabinet, away from the notes. As part of the consent process for this project component, GPS coordinates of wolffish bycatch on the fishing grounds have been kept confidential, only to be published in combination with coordinates collected from other harvesters in order to hide the location of the fishing grounds of the participating harvesters. The information from the onboard observation, including comments by harvesters, was categorized and entered into a spreadsheet to facilitate analysis of the larger set of observations.

Figure 3.1: Map of the study area, which includes NAFO divisions 3Pn4R.

3.3.2. Harvester Interviews

Twenty-one local fish harvesters (out of 25 contacted in July and August of 2009) agreed to participate in face-to-face, semi-structured LEK interviews. These interviews were completed in communities along the west coast of Newfoundland between Rose Blanche and St. Paul's. Interviewees were once again chosen from lists given by other researcher, the FFAW, and from harvester recommendations. For each interview there were two researchers present. Interviews were done one-on-one in a quiet area, often a person's house.

Harvesters were first asked to provide some basic demographic information including information about their fishing careers. Next, they were given an identification card from Intervale Associates and Fisheries and Oceans Canada (DFO) showing the three species and asked to identify which species they had seen, local names, relative numbers, and distinguishing features. Harvesters described wolffish species by appearance and from the cards identified the species correctly. Each card had scientific and common names written on it, but all harvesters initially described the species using their own local names (generally 'catfish' for *A. lupus* and *A. minor*). Harvesters classified wolffish based on visual observation of the skin and other features, as was done during the onboard observations During RV surveys scientists also described species by sight. Scientifically, the most reliable biological way to readily differentiate wolffish in the lab is by their dentition, however this method is difficult to implement for onboard identification. While not perfect, identification by field marks was used consistently across each method of study and dataset examined for this thesis. This is further discussed in the morphology and species identification section below.

Following identification we discussed their fishing history including species targeted, gear specifications, trends in catches, wolffish characteristics, and fishing ground characteristics. Fishing grounds were recorded either on paper (n=6) or electronic (n=15) versions of the Canadian Hydrographic Service (CHS) nautical charts. They then

described the different fisheries that they had participated in at the beginning of their careers and more recently (end or recent seasons) and the related fishing grounds were recorded on the charts. Each marked area was assigned a number, and these numbers were listed on the chart and spoken into the recorder so we could connect chart objects to information in the transcript. Harvesters were asked to talk about wolffish biology, abundance, and distribution on their grounds. Towards the end of the interview harvesters were asked about their views of the listing of wolffish and their experiences with wolffish and with related conservation measures in their area since the listing.

Following the interviews, all interview recordings were transcribed. During preliminary analysis of the transcripts, excerpts were sorted into the following broad categories: demographics, fishing history, listing opinions, and conservation. The information in each of these categories was then coded into a series of finer categories and quotes were inserted into the relevant fields. In the fishing history section of the database, the numbers linked to corresponding points and polygons on the digital charts were inserted, along with the corresponding fishery and wolffish information from the transcript.

Composite charts containing data from all harvester interviews were created by combining mapped fishing grounds associated with each major area studied. Fishing grounds were denoted by polygons with numbers linking them with the corresponding fishery and wolffish information from the transcript. Frequency of responses were analyzed.

3.3.3. Fisheries Science Stock Assessment Data

ECNASAP Data

The East Coast of North America Strategic Assessment Project (ECNASAP), initiated in 1991, is a collaborative effort across US and Canadian agencies. ECNASAP was designed to make maximum use of existing data, information, and knowledge by developing comprehensive information and map products. The Groundfish database

contains merged data sets with trawl data collected between 1970 and 1994 from Cape Hatteras, North Carolina, USA to Cape Chidley, Labrador, Canada (Brown et al., 1996). Data for 3Pn and 4R contained in the ECNASAP database were from DFO research vessel survey results generated from randomly generated, depth-stratified fishing stations, bottom trawl gear.

Regressions for catch per unit effort (CPUE) yearly averages against year were determined for all three species of wolffish in 4R from 1970 to 1994. Overall distribution was determined from the groundfish distribution atlas maps. These maps are generated using a combination of data from the Scotia-Fundy region, southern Gulf region, northern Gulf region, and Newfoundland region of DFO. These three maps were extracted from the atlas and used as a comparison for the mapped Sentinel data in the northern Gulf of St. Lawrence.

Mobile Sentinel Fishery

The Groundfish Sentinel Program, initiated in 1994, is a series of research activities where government funds and proceeds from Sentinel catches have been used to engage commercial groundfish fishers over sections of the Atlantic Coast in structured fishing for scientific purposes (Fréchet et al., 2009). Data resulting from this program for 3Pn and 4R were obtained from DFO. The Sentinel program is divided into mobile and fixed fishing gear sampling. Mobile fishing gear are trawls while fixed gear include covered pots, longlines, and gillnets. Only the data from the mobile sentinel fishery were used in this study due to the broader spatial and temporal scopes in this dataset and the extremely low wolffish catches in the fixed gear sentinel survey data. Mobile Sentinel survey data resulting from this program were obtained for 3Pn and 4R for the years 1999 to 2008. The dataset included both presence and absence hauls.

Mobile gear Sentinel survey data were collected from fishing stations that were randomly generated, following a depth based stratification (the variable most likely to influence

groundfish distribution) for depths ranging between 40 and 400 m outside of bays and fjords. Surveys took place during the beginning week of July and, from 1995 to 2002, in October. Surveying was done using shrimp trawl gear equipped with rock hoppers, calibrated using a catch control system and restrictor cables to reduce variability in wing spread (16.5 m) (Fréchet et al., 2009). Five vessels performed approximately 300, 15-30 minute tows at 2.5 knots at pre-determined depths and locations during each survey. The data for all five vessels were combined during analysis due to the calibration.

Mobile Sentinel data include gear used, fishing effort, species, fishing site, and total weight and length of fish caught. Composite maps of relative abundance and distribution for all three species in 4R and 3Pn were created using mapping software. Expanding bubble plots were created, dividing the data by year and species. Length data was extracted and used to compare inshore catches to deeper, offshore surveys. Adult to juvenile ratios in both interview data and stock assessment surveys were calculated for *A. lupus*. Length at maturity in 3Pn and 4R is not known but is assumed here to be 55cm (McRuer et al., 2000).

3.4. Results

3.4.1. Onboard Observation

Table 3.1 summarizes observations collected during the six fishing trips, including the catch per unit effort (CPUE).

Table 3.1: Wolffish catches on the six onboard observation trips. (*lup* = *A. lupus*; *min* = *A. minor*; *dent* = *A. denticulatus)*

Area	Fishery	Date (2009)	Hours out	Depths fished (m)	Gear amount	Number of wolffish hauled	CPUE (per pot or hook)
Bonne Bay	Lobster	13 May	7	2 – 16	200 pots	-	-
St. David's	Lobster	18 May	5	5 – 32	200 pots	1 (*lup)*	0.005
Rose Blanche	Lobster	11 Jun	7	2 – 20	150 pots	-	-
St. George's	Lobster	15 Jun	10	1 – 20	400 pots	-	-
Ship Cove	Lobster	16 Jun	3	5 – 30	40 pots	7 (*lup)*	0.175
Port aux Basques	Atlantic cod	04 Aug	3	90 – 120	5 strings of 1000 hooks	15 (3 *lup*, 7 *min*, 5 *dent*)	0.0006 *lup*, 0.0014 *min*, 0.001 *dent*

Variability in catch per unit effort (CPUE) of *A. lupus* from the lobster and cod hauls ranged between 0 and 0.175 per pot/hook. The lobster fishery CPUE in Ship Cove was between 5.8 and 291 times higher than the CPUE in both the lobster and cod fisheries in all other areas. Notes from the Ship Cove trip indicate that, for this harvester, this wolffish abundance was usual for these grounds.

The average lengths of *A. lupus* from the cod fishing trip were larger than those from the lobster fishing trips (Appendix F). This could be explained by the size restrictions associated with the design of the lobster pots. The portal for entry into the pot is created by using a ring size of between 4" ½ and 5." A portal this size would only allow small and mid-sized wolffish to enter. Smaller wolffish would be able to slip out of the pots and would thus would not appear in the lobster catches. The average lengths of *A. minor* and *A. denticulatus* caught on the longlines were much larger than those for *A. lupus*. These wolffish lengths will be compared with average lengths in survey data in chapter 3.

The hauls on the cod fishing trip included bycatch of all three species of wolffish whereas all harvesters on the lobster trips commented that the main wolffish species caught in lobster pots was *A. lupus,* with *A. minor* intercepted only occasionally. Only *A. lupus* was caught on the lobster trips observed. In Bonne Bay and Rose Blanche, where no wolffish bycatch was observed, harvesters commented that there weren't a lot of wolffish in the area.

3.4.2. Harvester Interviews

The 21 harvesters who participated in the wolffish interviews had fishing careers that range between 13 and 39 years (mean = 28 years) duration. They described on average 3.6 fisheries they had participated in and were generally skippers of their own boats (n=18) (Appendix G). The shortest interview ran 23 minutes while the longest ran 1.06 hours (mean = 43 minutes). The length of the interview depended on the number of years they had been catching wolffish, the size of their catches, the number of fisheries they participated in, and the extent of the discussion evoked by the questions.

Harvesters described their wolffish bycatches in Atlantic cod (*Gadus morhua*, Gadidae) (19 of 21 harvesters), American lobster (*Homarus americanus,* Nephropidae*)* (20), snow crab (*Chionoecetes opilio,* Oregoniidae) (11), halibut (*Hippoglossus hippoglossus,* Pleuronectidae*)* (10), lumpfish (*Cyclopterus lumpus,* Cyclopteridae) (10), winter flounder (*Pseudopleuronectes americanus,* Pleuronectidae*)* (2), commercial bait fish (capelin (*Mallotus villosus,* Osmeridae*)*, herring (*Clupea harengus,* Clupeidae*)*, mackerel (*Scomber scombrus,* Scombridae) (1), grey sole (*Glyptocephalus cynoglossus,* Pleuronectidae*)* (1), and salmon (*Salmo salar,* Salmonidae*)* (1) fisheries. Several harvesters (n=5) were also involved in DFO's groundfish Sentinel program for both fixed (n=4) and mobile gear (n=2) and their observations during Sentinel fisheries were also included in the observations discussed in the interviews.

Gear types used by harvesters over their careers and discussed in the interviews included longline (J and circle hooks), lobster pots, gillnets (lumpfish 10 – 10 ½" to 11-11 ½" mesh; cod 5 ½ - 6" mesh; other groundfish 7" mesh), Danish seines, and crab pots. Depths fished ranged from 2 m (with lobster pots) to 500 m (with crab pots and longlines). Months on the water ranged from April to November, with a winter cod fishery in the past and some in 3Pn still fishing cod in the winter (December to March) (see Dawe 2010 chapter 2 for further information).

When asked to identify wolffish species they had hauled up in their fisheries, all 21 harvesters reported catches containing *A. lupus* and *A. minor* in Atlantic cod, lobster, lumpfish, halibut, winter flounder, grey sole, and snow crab fisheries during the past and present summer fishing seasons (April to September) and the past winter seasons (November to January-February). Sixteen reported catches of *A. denticulatus* from cod, halibut, and snow crab fisheries during the past and present summer fishing season and past winter season.

3.4.3. Depth

When asked to identify and map areas where they had caught wolffish, harvesters charted areas less than 350 m in depth. The depth concentration for each species varied. While caught in the entire depth range of the fishing gears (Figure 2.2), harvester reports of *A. lupus* were most common in shallow waters (2-40 m) in all areas, though they were also caught in deeper waters in Bay St. George and Port aux Basques (3.2). Figures 3.2 through 3.4 are composite charts created from information collected in these harvester interviews. Each polygon represents a fishing ground where wolffish were reported to have been caught. Charts do not indicate presence and absence; areas outside polygons do not represent areas without wolffish, only areas harvesters did not include in their fishing grounds or fishing gears that did not catch wolffish, such as shrimp trawls fitted with Nordmore separator grates to reduce bycatch.

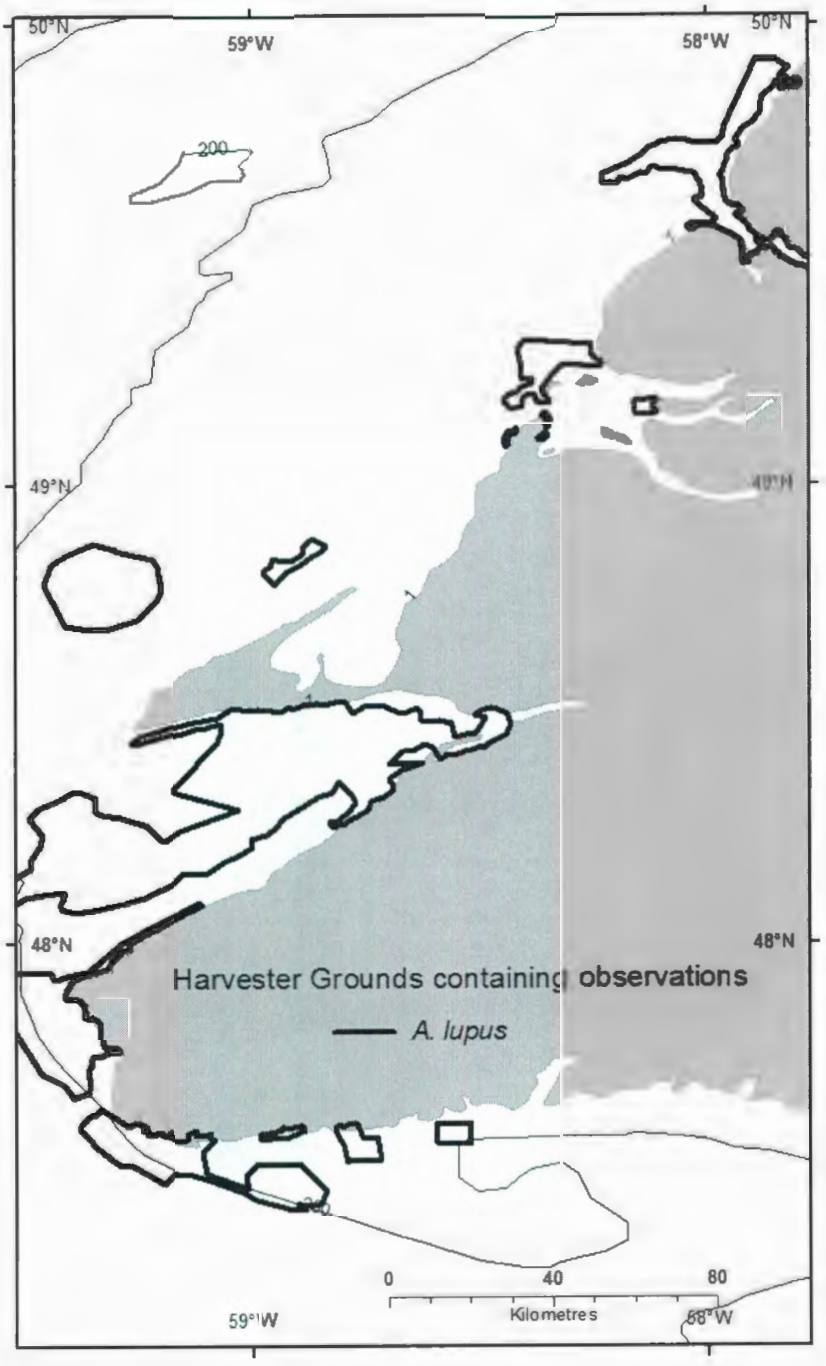


Figure 3.2: Harvester interview composite charts for *A. lupus*.

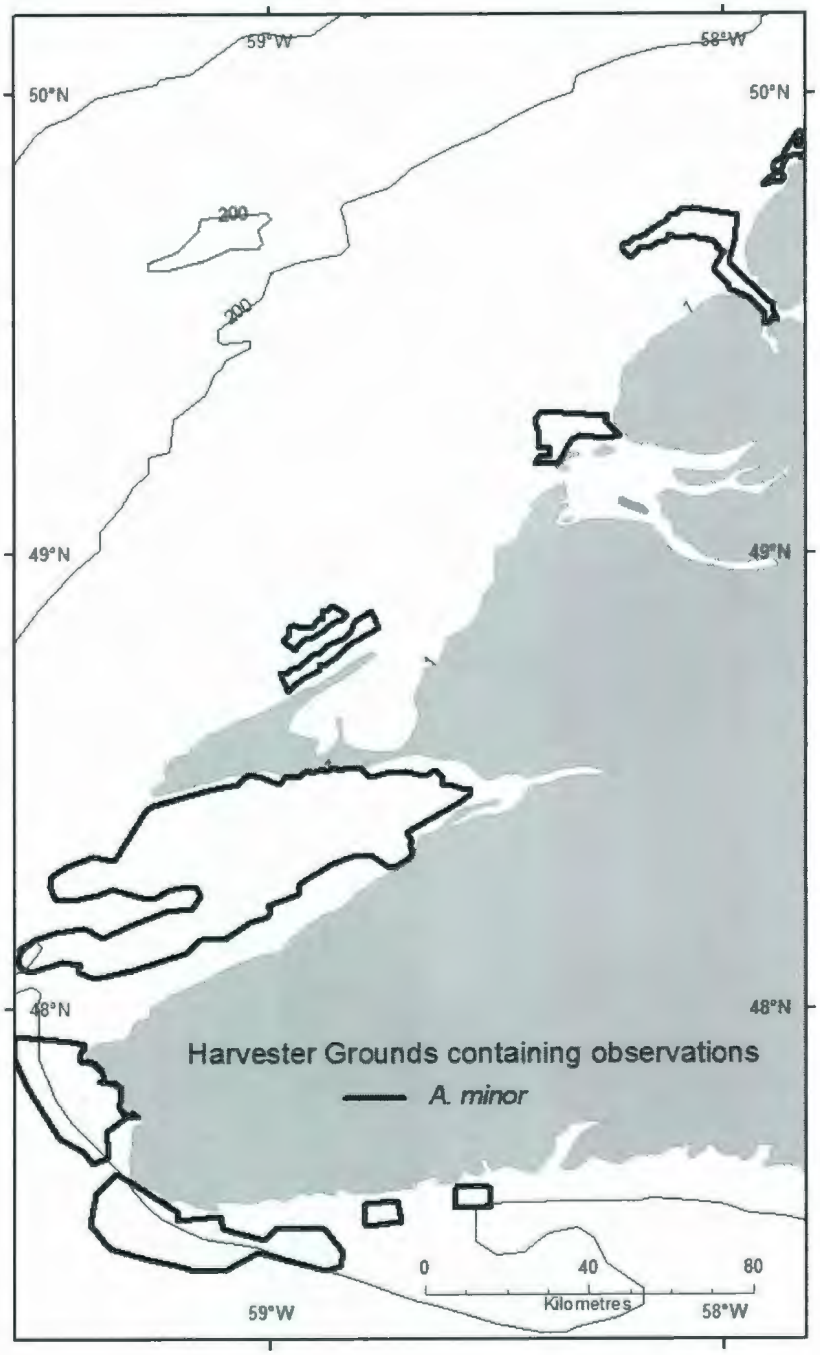


Figure 3.3: Harvester interview composite charts for *A. minor*.

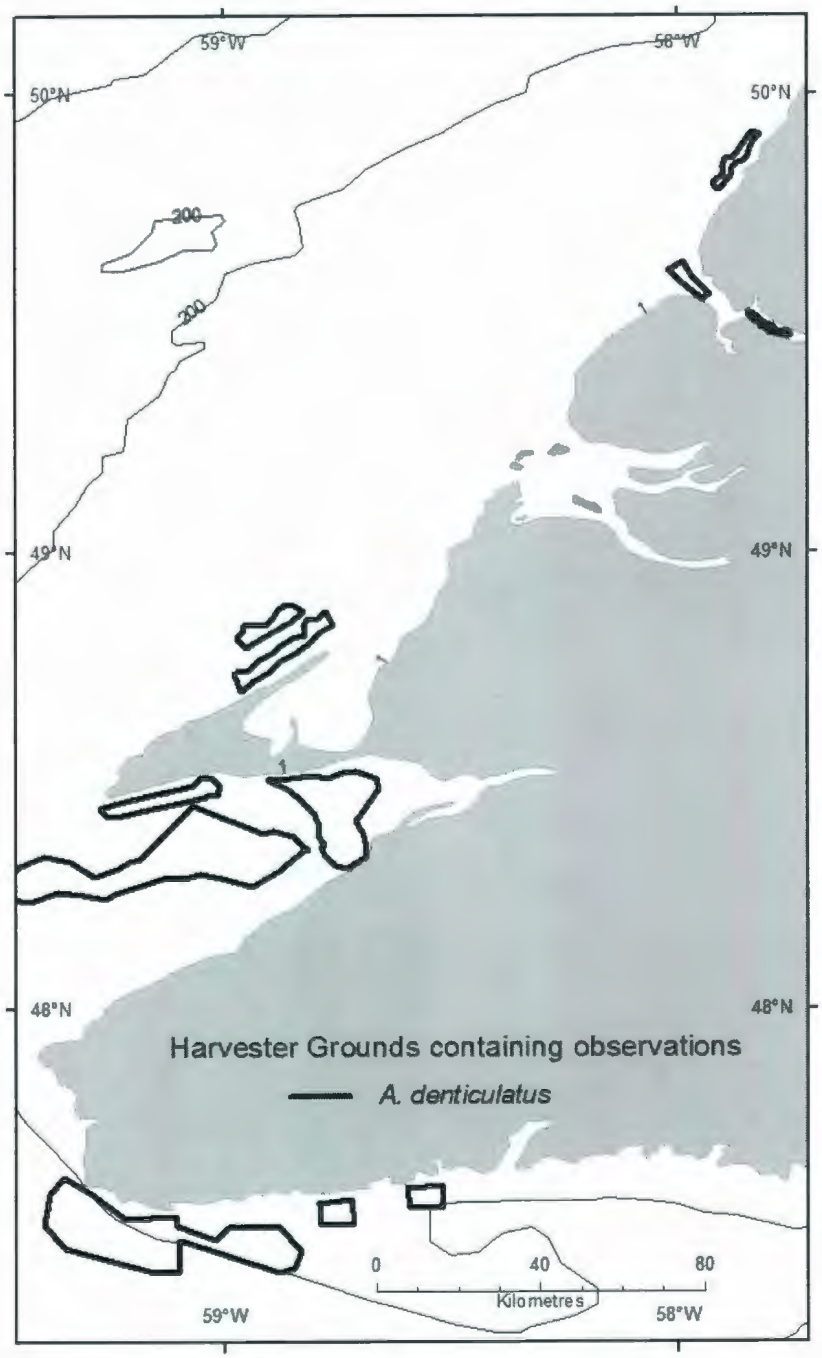


Figure 3.4: Harvester interview composite charts for *A. denticulatus*.

When asked when in their fishing season they had seen wolffish, harvesters reported that wolffish weren't seen consistently throughout their fisheries. Ten harvesters reported that the depths associated with wolffish catches changed over the season.

> **H**: The early part of the season you don't get no catfish at all....it seems then a little later in the season you start picking up some.
> (Harvester interview #10 – Bonne Bay Lobster fishery).

Based on these observations, harvesters thought that wolffish moved to shallower depths as the summer progressed, then disappeared from their grounds by late August (see Dawe 2010 Chapter 2).

A. minor, though often reported in the same depths as *A. lupus*, were caught more commonly in the deeper (40-150m) part of the range (Figure 3.3).

A. denticulatus appears to be confined to deeper waters as they are not often caught in inshore fisheries. Harvesters reported catching them from 100- 350 m (Figure 3.4).

3.4.4. Sizes

When asked about the sizes of the wolffish intercepted by their gear, harvesters consistently reported large wolffish (0.60 – 2 m) in the inshore fisheries. During onboard observation all wolffish, from both lobster pots and longline hooks, were larger than 0.65 m (Appendix F). *A. lupus* was the smallest of the three species observed in their gear; harvesters assumed this was due to the fact that most were caught in lobster pots, which exclude large wolffish while smaller ones can escape.

> **H**: Now when we fishes out here in deeper water we'd probably get [*A. lupus*], and if we get them out there they're small ones. We don't get the real big ones in our lobster pots, 'cause our ring size is only that big. (Harvester interview #4)

Harvesters reported *A. lupus* sizes ranging from 0.6 – 1.2 m and from 2-5 kg (n= 12). *A. minor* were reported to be much longer and larger than *A. lupus*; the few *A. minor* caught in lobster pots were reported to be 3-4 times the size of *A. lupus* (n = 4). Based on the interview data, the average sizes of *A. minor* ranged from 1-2 m and13-27 kg. *A. denticulatus* were also reported to be large with sizes ranging from 11-23 kg. No lengths were given for this species. Reported sizes were assumed to be from recent years by the interviewer. Eleven (n=11) harvesters reported that all three species were larger since the listing had occurred and that only small numbers of *A. lupus* could be kept.

3.4.5. Catch Rates

Harvesters were asked to describe their catch rates for each species on their different fishing grounds. These catch rates varied greatly among areas and wolffish species. Both past (beginning of career) and present (current season) catch rates were divided into low and high rates; low catch rates, described by 12 harvesters, represented fewer than 10 wolffish caught during a week or a season. High catch rates, described by eight harvesters, represented over 10 wolffish caught during a week. High catches ranged upwards to 80 wolffish, of all species, a day. Harvesters did not report any consistent way of avoiding large catches of wolffish.

Current catch rates of all three species of wolffish reported by harvesters were compared to catch rates from the beginning of their careers to determine relative trends (Table 3.2). Harvesters reported either no change (n=7) or increased catch rates (n=12) of *A. lupus* over their careers (mean = 28 years). Four harvesters from Bay of Islands to St. Paul's reported reduced numbers in their catches from the beginning of their careers (1970s) to the current season for *A. denticulatus* and *A. minor*. No correlation between catch rates (high or low) and observed trends (no change, higher catches, lower catches) was found (A. lupus $r(n=19) = -0.113$; $p = 0.625$; A. minor $r(n=19) = 0.025$, $p = 0.913$; A. denticulatus $r(n=19) = -0.081$, $p = 0.727$).

Figures 3.2 to 3.4 show a broader spatial distribution of all three species of wolffish from Rose Blanche to Bay St. George than from Bay of Islands to St. Paul's. These broader distributions are reflected in higher catch rates, both past and present. In general, catch rates of all three species of wolffish increase to the south in the Atlantic cod, lobster, halibut, and lumpfish fisheries.

3.4.6. Fisheries Science Stock Assessment Data

Table 3.2: Trends in catch rates of *A. lupus*, *A. minor*, *A. denticlatus* by area surveyed, fisheries data source, and time frame.

Area	Source of Data	Time - Start	Time - Stop	Wolffish species	Trend
Northern Gulf of St. Lawrence (4R)	ECNASAP	1970	1994	*A. lupus*	Non-significant decline
				A. minor	
				A. denticulatus	
Northern Gulf of St. Lawrence (3Pn4R)	Sentinel (mobile gear)	1999	2009	*A. lupus*	Increase (non-significant)
				A. minor	Data deficient
				A. denticulatus	
Waters around Newfoundland and Labrador majority on Grand Banks and the eastern shelf) (no NAFO divisions listed)	Species Status Reports (O'Dea and Haedrich, 2000, O'Dea and Haedrich, 2001b, O'Dea and Haedrich, 2001a)	1978	1993	*A. lupus*	91% decline
				A. minor	97% decline
				A. denticulatus	98% decline
Waters around Newfoundland and Labrador (2J3KLNO4RSVW - majority in 3LNO)	Recovery Plan (Kulka et al., 2007)	1977	2001	*A. lupus*	Over 90% decline
				A. minor	
				A. denticulatus	

ECNASAP Data

The ECNASAP data for the Northern Gulf showed non-significant negative trends in CPUE in 4R from 1970 to 1994 for all three species of wolffish (Figure 3.5). *A. lupus* shows the sharpest decline in CPUE for 2.78% per year ($y = -0.0278x + 56.04$) over the 24 year span, followed by *A. minor* with a decline of 0.39% per year ($y = -0.00393x + 7.91$) and *A. denticulatus* with a decline of 0.16% per year ($y = -0.0016x + 3.22$). In a larger sample size these rates might have been significant. These rates of decline apply only to the time interval of study, and cannot be extrapolated to the future.

Analysis of covariance showed no significant heterogeneity of slopes ($F_{2,66}=1.97$, $p=0.148$). The overall relation to year was negative but just short of significant ($F_{1,66}=3.47$, $p=0.067$).

The criterion for listing a species as Special Concern or Threatened by COSEWIC is a decline of $\geq$ 50%. The CPUE graphs show that, though the trends are non-significant, all three species meet the criteria; *A. lupus* from 1976 to 1991, *A. minor* from 1983 to 1994, and *A. denticulatus* from 1981to 1990. These declines are based off low catch rates for the entire time series and, in the case of *A. minor* and *A. denticulatus*, these trends may have been based off peak catch years.

Based upon maps from Brown et al. (1996), the following patterns were observed. All three species of wolffish were found to some degree in shallow waters (<200 m) of the Northern Gulf. In the rest of their Newfoundland range, however, they were concentrated in the deeper, offshore waters.

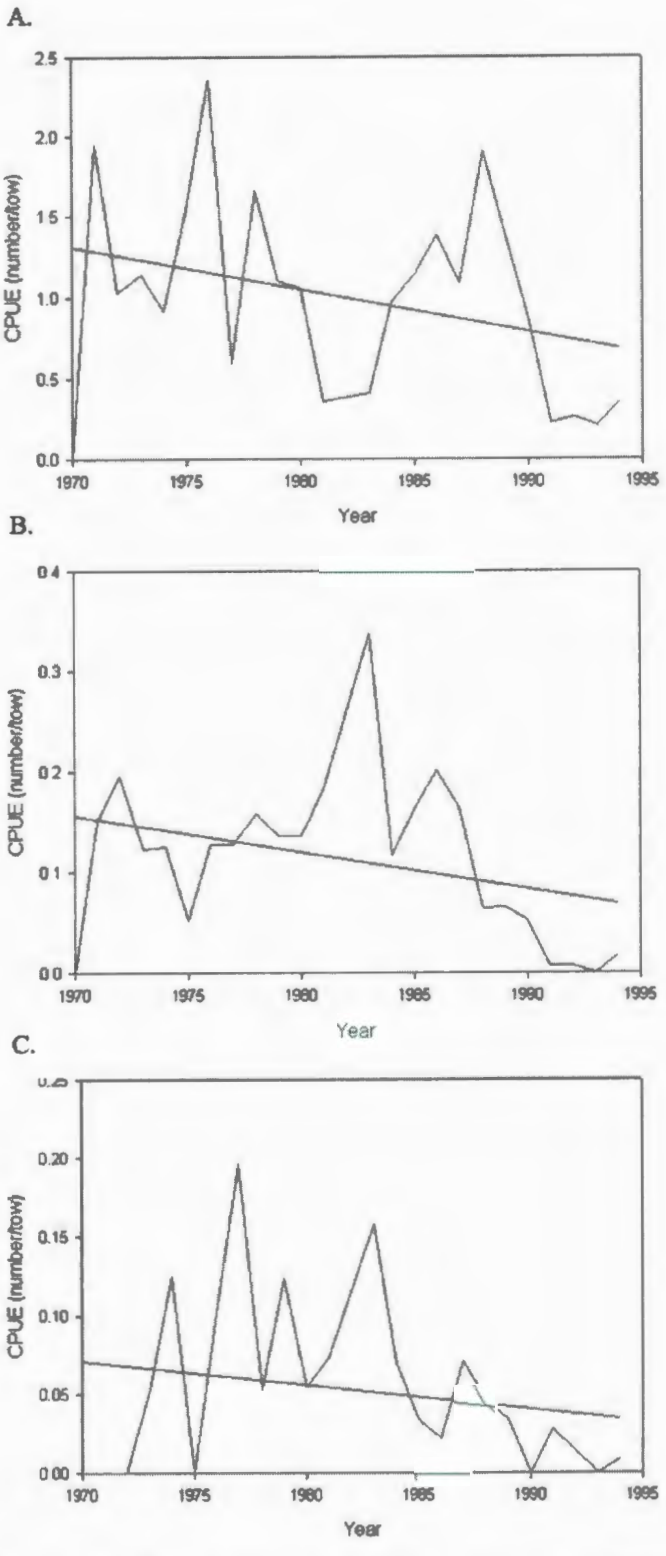


Figure 3.5: Catch per unit effort graphs using ECNASAP data for NAFO division 4R from 1970 to 1994 for a) *A. lupus*, b) *A. minor*, and c) *A. denticulatus*.

The overall range of *A. lupus* over the 24 years of ECNASAP data shows they are distributed throughout 3Pn and 4R up to Port au Choix (Brown et al., 1996). The highest catches were concentrated in the shallow waters of the Northern Gulf (<200 m) (Appendix J); surveys did not sample Bay St. George or shallow water from the Port au Port Peninsula to Port aux Choix. ECNASAP maps did not show trends in distribution over time.

A. minor distribution showed catches into the deeper areas of the Northern Gulf (>200 m) (Brown et al., 1996). This species was also distributed throughout 3Pn and 4R up to Port au Choix. The distribution of *A. denticulatus* was concentrated mostly offshore of the Northeastern part of Newfoundland. In the Northern Gulf of St. Lawrence they were reported in southern 4R and 3Pn. Only scattered catches during the time series were found between 0-200 m; most catches were in deeper offshore waters (>200 m).

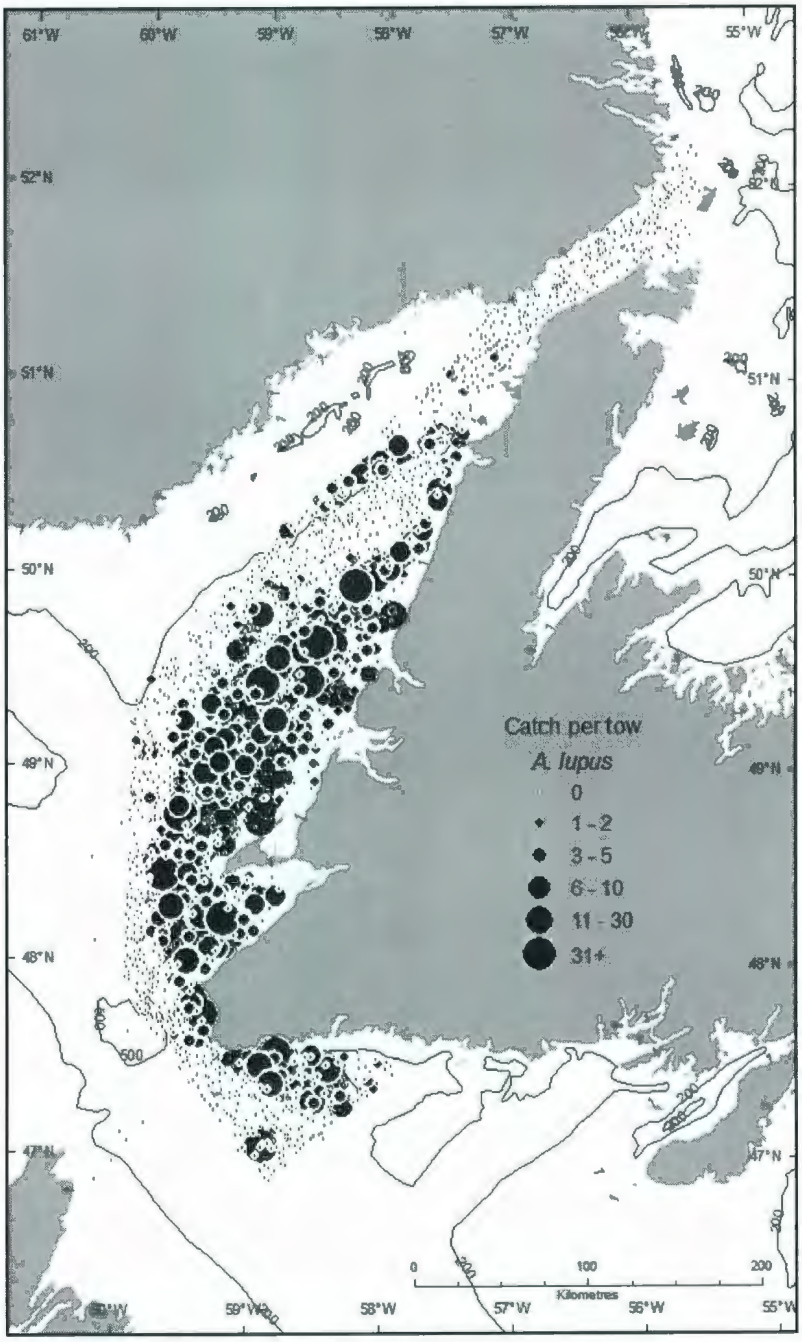
No wolffish were caught in the waters Strait of Belle Ile. Off the coast of Labrador and the northeast coast of Newfoundland wolffish were only found in deep waters (>200 m).

Sentinel Fishery Data

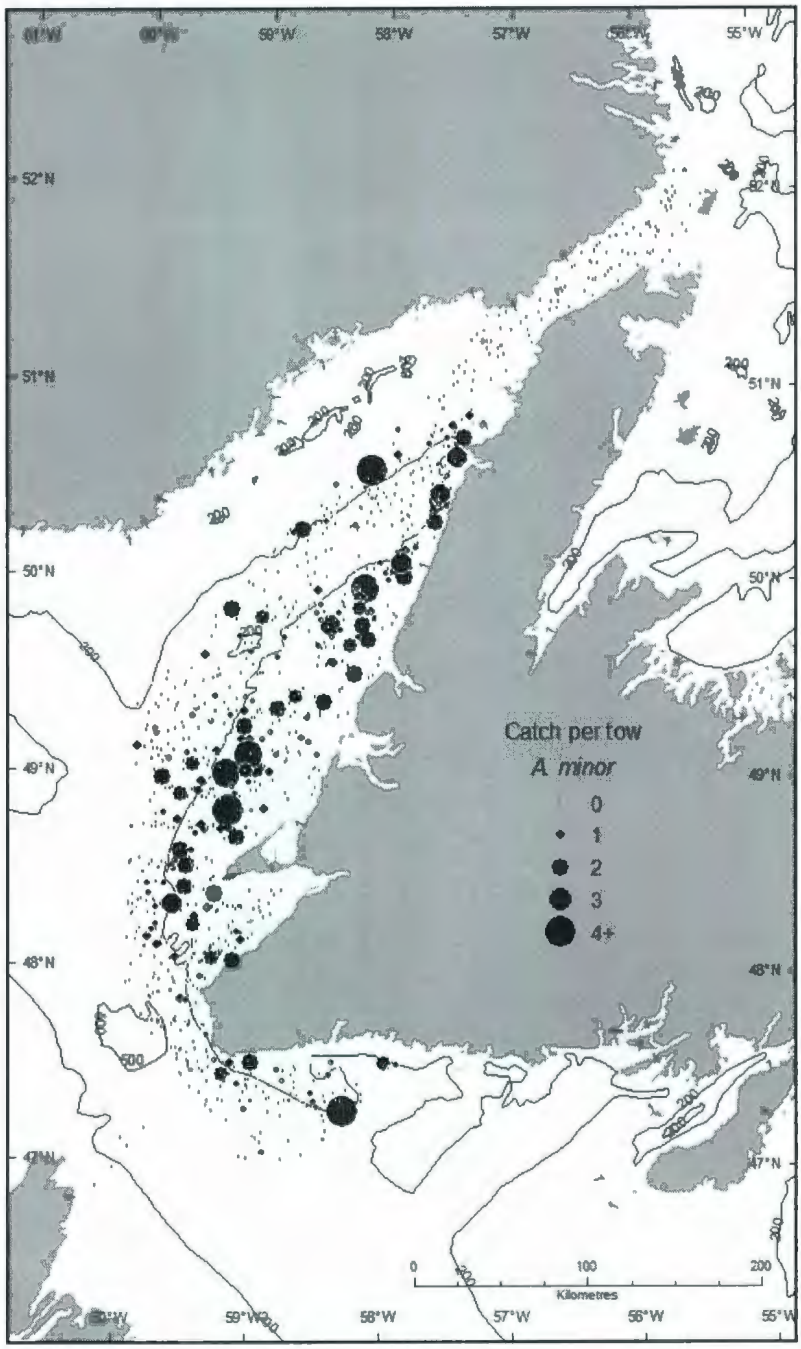
In mobile gear Sentinel surveys catches of both *A. minor* and *A. denticulatus* were too low to calculate CPUE. For *A. lupus* CPUE (number/tow) seemed to increase over the time period in 4R and appeared to remain stable in 3Pn (Figure 3.6), though the trends had no reliability due to the variability in catch rates. No consistent predictor of catch size was found for any of the three species.

All three species were found in the full southern range of the Sentinel survey (down to Burgeo on the south coast). In the northern extreme of the range only seven *A. lupus* were found further north than Port aux Choix. No *A. minor* or *A. denticulatus* were found further north than Port aux Choix.

a)


61°W
60°W
59°W
58°W
57°W
56°W
55°W
52°N
51°N
50°N
49°N
48°N
47°N
Catch per tow
A. lupus
0
1 - 2
3 - 5
6 - 10
11 - 30
31+
0
100
200
Kilometres

b)


61°W
60°W
59°W
58°W
57°W
56°W
55°W
52°N
51°N
50°N
49°N
48°N
47°N
200
500
Catch per tow
A. minor
0
1
2
3
4+
0
100
200
Kilometres

c)

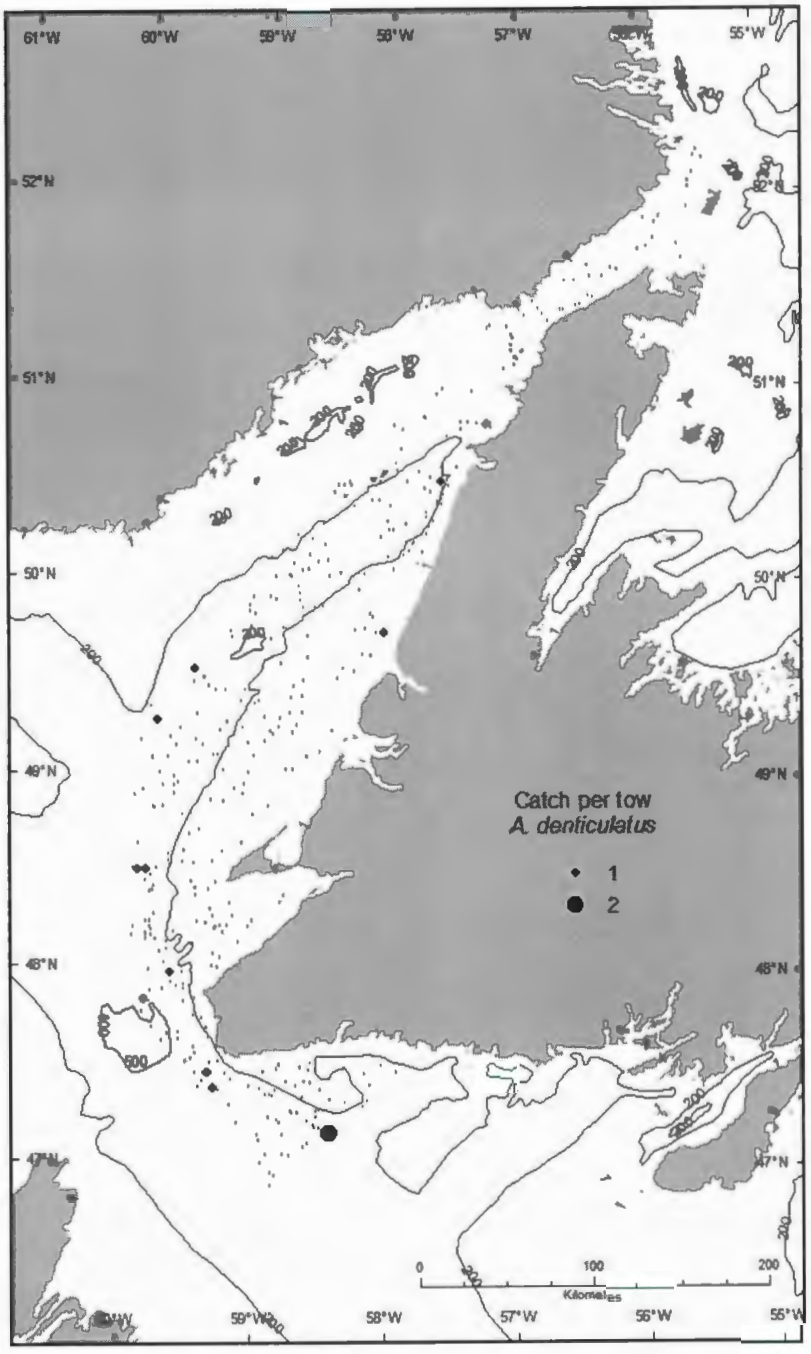


Figure 3.6: Distribution of a) *A. lupus*, b) *A. minor*, and c) *A. denticulatus* in the Northern Gulf (3Pn4R).

Most of the *A. lupus* and *A. minor* intercepted in the Sentinel surveys were caught in waters under 200 m of depth from Bay of Islands to Bay St. George. The depth distributions of *A. lupus* and *A. minor* overlap between 50 – 200m. Few of either species were caught outside of 200 m. Only 12 *A. denticulatus* were intercepted over 1991-2008, and only one of these was caught in depths less than 250 m. No trends in distribution, assessed visually by year on maps, were found for any of the three species in the Sentinel data.

Length frequency histograms from 1998 to 2008 for *A. lupus* showed a positive skew away from modal values of around 150-250 mm (Figure 3.7). The majority of fish from 1998-2004 consisted of juveniles (less than 550 mm). From 2004-2008 the distribution became bimodal, with a second peak around 500-650, showing an increase in adult *A. lupus*. From this data, the juvenile:adult ratio for *A. lupus* in 3Pn and 4R was 9.8:1 (n=1942).

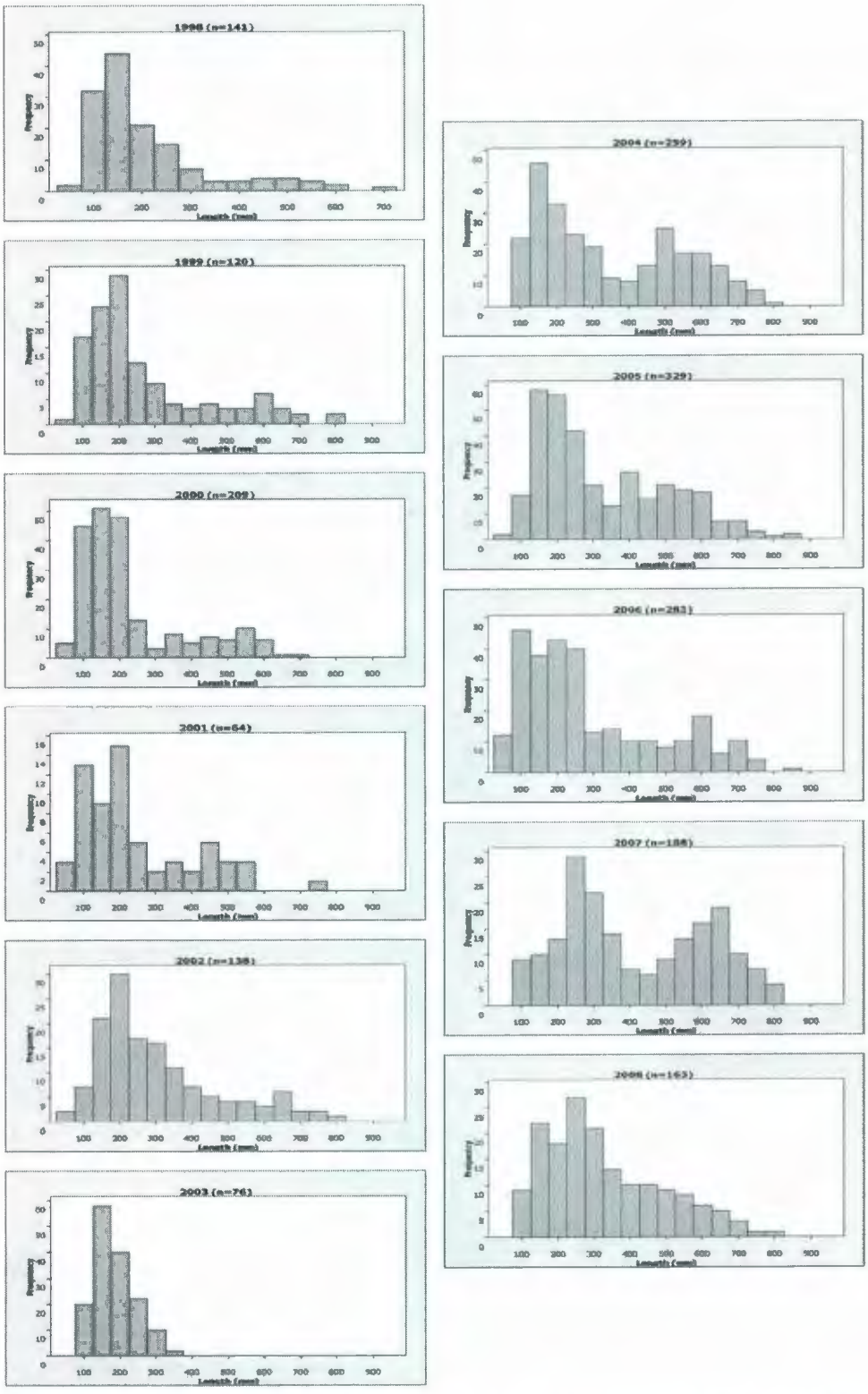


Figure 3.7: Length frequency histograms for *A. lupus* for 4R from 1998 to 2008.

3.5. Discussion

To date there have been no studies that have examined whether LEK and science can be used to mutually strengthen species at risk assessment and legislation. To use both types of data in this way there must be criteria for comparison and evaluation. The criteria we applied were a general concurrence with no inconsistencies and a degree of complementarity. This case study of wolffish in the Northern Gulf of St. Lawrence showed that scientific stock assessments and data from LEK interviews can be used conjointly given these three criteria. Results showed that there was a consistency in observed trends and locations of high wolffish catch rates from both harvester LEK interviews and ECNASAP data. There was inconsistency between observed variability in catch sizes in harvester interviews, onboard observation, and stock assessment maps. However, daily catches will, by definition, be more variable than averages over longer times or longer areas. Finally, results from wolffish size assessment from onboard observation, harvester interviews, and Sentinel data are concurrent in that adult wolffish were found in inshore catches and juveniles in offshore catches. The LEK and science data were complementary in that observations took place at different spatial and temporal scales. They were complementary in that LEK was inshore, compared to science data from offshore.

Wolffish are distributed throughout most Newfoundland waters. Documented areas of concentration include the Grand Banks and the Northeast coast (Scott and Scott, 1988). Even in these areas, wolffish have been relatively rare in number over the sampling period. ECNASAP data for all of Newfoundland and Labrador show that the peak catch rates for *A. lupus* (the most common species) were seven per tow from 1975-1979 in their entire range and decreased to three per tow from 1980 to 1994. Population sizes have never been high or consistent enough for any of the three species to sustain a directed fishery; all wolffish landings and discards to date have been due to bycatch.

The lack of a directed fishery coupled with low population numbers are among the reasons why wolffish were not heavily studied or monitored in the past. Recently there has been an increase in wolffish research in Canada. This increased research attention is a result of the listing of these three species under SARA. Most of the recent research has focused on their abundance, molecular biology, and their use as an aquaculture species, with less research taking place on ecology and biogeography. The research presented in this chapter indicates that, for wolffish, an examination of harvester LEK supplemented by regional scale analyses of stock assessment data can lead to a better understanding of the species and increasingly protective implementation of species at risk legislation.

ECNASAP and Sentinel data show that wolffish had a more southern distribution in areas 4R and 3Pn. In onboard observations and harvester interviews, catch sizes reflected a southward trend in wolffish distribution on the associated grounds. Harvesters fishing from Bay of Islands to St. Paul's caught, on average, less wolffish than those fishing further south in Rose Blanche to Bay St. George in similar fisheries.

Both the onboard observations and the harvester interviews suggested both spatial and temporal variability in wolffish distribution along the Newfoundland coast of the Northern Gulf of St. Lawrence. The reasons for this variability are unknown, but may be related to habitat selection, feeding, or spawning requirements. The Sentinel and ECNASAP maps do not show this variability trend and offer no consistent predictors for catch sizes. This may be due to the sampling depths or gear of the trawls.

Offshore Sentinel data provided a different picture from LEK interviews which tend to be based on inshore observations. In NAFO divisions 3Pn and 4R both ECNASAP and Sentinel data show both *A. lupus* and *A. minor* in inshore (<200 m) waters and *A. denticulatus* in offshore waters (>200 m). Harvesters reported *A. lupus* most commonly in waters 2 – 40 m, *A. minor* in waters 40 – 150 m, and *A. denticulatus* in the deepest waters from 100 – 350 m. In contrast, the ECNASAP groundfish distribution maps show that in other waters around Newfoundland wolffish are found in much deeper, offshore waters

than appears to be the case in the Northern Gulf. Charts created from both Sentinel and ECNASAP data also show an absence of wolffish from Port aux Choix, up the Strait of Belle Isle, to the offshore waters of the Northeastern coast.

These distributions can be explained by the influence of the Labrador Current. The Strait of Belle Isle is influenced by the Labrador Current through tides and currents. Temperatures in this area are the coldest in the Northern Gulf (DFO, 2007). While wolffish can survive in freezing temperatures due to antifreeze proteins in the blood, similar to those of the winter flounder (Scott et al., 1988), they are most often found in a range of 2-5°C (Beese and Kandler, 1969). Therefore, all three species of wolffish had limited the extent of their distribution to the waters south of Port aux Choix on the Northern Gulf and to the deeper offshore waters of the Labrador and Northeastern Newfoundland coast.

Wolffish sizes reported by harvesters during interviews and seen during onboard observation suggest that a high ratio of adults (length of > 55 cm) are caught in various gears, including lobster pots, gillnets, and longlines, in inshore fisheries. In contrast, Sentinel data in deeper waters, using trawls, showed an overwhelming trend towards juvenile wolffish. This can be explained by segregation by water depth of adults and juveniles during the summer months with juveniles remaining in deeper waters for feeding and to escape predation, while adults migrate to shallower waters. Nelson and Ross (1992) reported that with increasing depth *A. lupus* segregate themselves by size. They showed that from March to May adult wolffish comprised the largest proportion of catches in waters less than 120 m, while the ratio of juveniles increased with depth.

The high ratio of adults in inshore waters during the spring and the subsequent decline during the fall as reported by harvesters can be explained by seasonal inshore-offshore movement (Nelson and Ross, 1992, Pavlov and Novikov, 1993). This migration inshore accompanies a lowering of feeding activity for mate choice and reproduction. Non-breeding juveniles do not make the migration inshore and instead remain offshore.

Breeding and egg guarding by adult males during the fall (September to December) may also explain catch declines reported by harvesters (Keats et al., 1985) *A. minor* is assumed to follow this trend (Bigelow and Schroeder, 2002), while *A. denticulatus*, rarely found in shallow waters, is assumed to remain in deeper waters. It is unknown if there is any segregation of adults and juveniles for this species.

Another explanation for the segregation of adults and juveniles during summer months comes from the Sentinel trawl offshore sampling methods. Other research vessel surveys have reported size biases due to sampling gear and methodology as they do not sample mature fish well (McRuer et al., 2000). Sentinel data may follow this trend. If stock assessment methods only sample juveniles then an estimate of adult abundance is not possible.

The high ratio of adult wolffish reported in inshore fishery catches by harvesters would have detrimental consequences for wolffish conservation if coupled with low survival rates. However, since the listing of wolffish in 2003 under SARA all three species of wolffish have to be released alive when caught, the exception being for *A. lupus*. Two hundred pounds per day (or 10% of the daily catch) of *A. lupus* can be kept for sale (Kulka and Simpson, 2004). The live release of wolffish has been shown to result in a high survival rate, even days later (Grant et al., 2005). A high survival rate of released wolffish is also consistent with the reported increased sizes of wolffish being caught.

A high survival rate is consistent with harvester reported changes in wolffish catch rates over their careers. Only four harvesters reported lower numbers of *A. minor* and *A. denticulatus* from the beginning of their career (1970s) to the current season, and no harvesters in the study reported lower numbers of *A. lupus*. ECNASAP data for NAFO division 4R in the northern Gulf of St. Lawrence also showed this trend, which is consistent with the status report (Kulka et al., 2007). There was little change in wolffish population numbers in other areas of the Gulf of St. Lawrence and the Scotian Shelf,

which contrasts with the steady decline in population size of wolffish on the Eastern Shelf of Newfoundland and the Grand Banks (Kulka et al., 2007).

Examining the ECNASAP data following the COSEWIC listing protocol shows that all three species have declined by greater than 50% and therefore meet the criteria for Special Concern and Threatened listings. However, the methodology for the COSEWIC listing uses a straight percent decline from highest to lowest catch rates in the time series. When you incorporate biases, such as anomalies in the data (i.e. peak or low years) and the low overall catch rates for all three species into the dataset, the original regressions of the data hold true and reveal that no significant change has occurred.

It is, however, hard to establish annual temporal trends in harvester reported catch rates for wolffish due to changes in season length, depth and areas fished in groundfish fisheries in particular, in recent years. These changes may have bias trends in reported numbers after the species was listed. It is also possible that harvesters are now paying more attention to these species as they have to be released alive. Research vessel catch rates in 4RST have shown an increase in wolffish numbers in recent years, which has been attributed to higher recruitment (McRuer et al., 2000).

The comparison of fisheries science data with data from commercial harvester LEK carried out in this paper is new for marine species at risk in Canada. This study shows that, for future assessment and monitoring of marine species at risk, if the LEK collected and analyzed is internally consistent it can be compared to science for external consistency. Unquestioning acceptance of LEK is no more defensible then unquestioning rejection. The spatial and temporal scales of LEK and science differ, but, if findings are consistent, they can be used together to mutually reinforce.

The reported lack of decline in wolffish catch rates and range among interviewed harvesters in areas with traditionally high populations agrees with trends generated from ECNASAP stock assessment data, but not data from areas of higher wolffish abundance

around Newfoundland, such as the Grand Banks and the northeastern shelf. Areas with traditionally low populations of wolffish did not have high enough catches of wolffish in the past for a good comparison of trends. In the Northern Gulf of St. Lawrence this lack of observed decline has lead to questions of the legislation. Legislation is often perceived by harvesters as a political move, offering little help to harvesters. National legislation, necessary at a large scale, can lead to a local disconnect. While discrepancies between science and LEK such as this are often due to the differences in scales (small scale of inshore harvesters versus the larger scale of fisheries assessments), such discrepancies can lead to local deviation from regulation, and mistrust of the science basis for large scale regulation. Harvesters will follow regulations to prevent the penalties for disregarding them. The inclusion of harvester LEK, through consultations and meetings, jointly with an increasingly transparent scientific process would help the species at risk legislation process by eliminating some of the discrepancies between science and harvester knowledge.

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4. Species at Risk in Canada: Lessons learned from the listing of three species of wolffish.

4.1 Abstract

The Canadian Species at Risk Act (SARA) was implemented in 2003. To date, no fully marine Atlantic Canadian fish species has been listed through the full SARA process. There species of wolffish found in North Atlantic waters were grandfathered in to the list in 2003 following a listing under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This listing was based on limited scientific data from a relatively short time series of offshore trawl survey data. This case study of the wolffish listing draws on results from interviews with key informants familiar with the listing of wolffish, an analysis of existing documents and research on the SARA process, and Local Ecological Knowledge (LEK) interviews to compare stakeholder opinions on the wolffish listing process and draws suggestions for future improvements to the listing process for marine fishes. Results show that the wolffish listing process was unique for marine species at risk. Due to increased demands on science the listing protocol is far more rigorous today. Key informants talked about the listing of wolffish and changes associated with the implementation of SARA, including problems with increased demands on science linked to the threat of lawsuits, as well as the challenges and opportunities of finding funding for research. There were mixed views about the benefits and problems associated with the requirement for consultations and incorporation of stakeholder knowledge into the listing process. There is some evidence that the wolffish listing process has increased harvester stewardship and engagement and benefitted from their input into safe release of wolffish. Finally, little attention has been paid by any of the stakeholder groups consulted to the potential future delisting of wolffish under SARA, which is arguably the most important goal of species conservation. Without delisting requirements or timelines set up in a species recovery plan it is impossible to establish concrete guidelines for recovery.

4.2 Introduction

There has been increased concern in the last few decades about the status of marine fish species at local, national, and global scales. In recent years, such major international Conventions as the Convention on Biological Diversity, the Convention on Migratory Species, and the Convention on International Trade in Endangered Species have been applied with growing intensity to marine species. Many countries, including Canada and the United States, as well as the European Union, have legislation in place to help not only assess species, but in many cases to identify and protect those species most at risk.

Canada has long been concerned about the protection of its natural heritage and biodiversity (Government of Canada 2003a [1-2]). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of activism by environmentalists, scientists, and others who saw the creation of a single, national list of endangered species as essential [3-5]. It has the mandate of designating the conservation status of indigenous wildlife species at risk in Canada [2, 4, 6]. It is composed of a panel of experts, including independent scientific experts, conservationists [1], representatives of four federal agencies, three non-governmental conservation organizations (NGOs), and each provincial and territorial government [4].

A species-at-risk status from COSEWIC carries no legal consequences; the list appears as public documentation only. The intent of COSEWIC designations was, in the past, solely to draw official and public attention [3-4]. However, since its creation, there has been debate over the relevance of legislation relating to the conservation of species at risk [6]. To change this, the federal government tabled Bill C-65: An Act Respecting the Protection of Wildlife Species at Risk in Canada, which died on the *Order Paper* in 1997. A second bill, Bill C-33, was introduced and died on the *Order Paper* once again in 2000 [1].

Canada's new Species at Risk Act (SARA) came into force in 2003, and COSEWIC was given the legal mandate for scientific assessment of species with potential at-risk status [1]. The main objectives of the Act are to prevent wildlife species from becoming Extinct or Extirpated (extinct in Canada), provide for the recovery of species that are Extirpated, Endangered, or Threatened as a result of human activities, and to manage species of Special Concern [7]. It does this by creating a legislative basis for the scientific status of species at risk [1-2].

For a marine species to be listed today, it must first be recommended by COSEWIC (Figure 4.1). Recommendations are informed by IUCN criteria for population status, area of occupancy, and other life history traits. According to these criteria, a $\geq$70% decline in population numbers over 10 years or three generations results in an endangered listing, and a $\geq$50% decline in population numbers over 10 years or three generations results in a threatened listing [9]. The area that will be used as the basis to assess a population decline is decided by the Committee prior to analysis, and can include local or regional scale populations [10].

COSEWIC gives their list of recommended species to the Minister of the Environment, who, in consultation with the Minister of Fisheries and Oceans, the Minister of Canadian Heritage, and the Canadian Endangered Species Conservation Council (CESCC), examines the potential socio-economic impacts associated with listing the species and reviews the science in the status report [1]. Within nine months the Minister is expected to reach a decision to place the species on the official list, send the status report back to COSEWIC for re-assessment, or keep the species off the list entirely [1-2].

In comparison, listings under the US Endangered Species Act (ESA), enacted in 1973, are "based solely on the best scientific and commercial data available" [11]. The ESA is administered by two federal agencies, the United States Fish and Wildlife Service (FWS) and the National Oceanic and Atmospheric Administration (NOAA). At risk species are listed either directly by either of these two agencies through the candidate assessment

program, or an individual or organization can request a listing. Once a petition is received a service review is completed to assess whether the information given may warrant a listing. If a listing is warranted funds are allocated support information reviews and collection of new information [11].

In Canada, there has been growing governmental interest in the incorporation of Aboriginal and local knowledge into the species at risk process, as well as input from other kinds of stakeholders. To date, this has been done mainly in situations where policy makers must take into account Aboriginal rights [12-14]. Where Aboriginal land claims exist, the Minister will consult the relevant Wildlife Management Board and those Aboriginal peoples affected. COSEWIC now has an Aboriginal Traditional Knowledge (ATK) subcommittee to include ATK where available and applicable to species status reports, but COSEWIC bases its decisions on available knowledge and lacks the resources necessary to assemble ATK or other forms of local knowledge if this work has not already been done.

Before the federal government makes a decision on the status of a recommended species, Environment Canada distributes the status report to stakeholders and posts the document on the SARA public registry for public consultation. All provinces and territories that would potentially be affected by a listing are also contacted by Environment Canada. Consultations occur with those Canadians potentially affected by a listing regarding the social and economic impacts that could result from placing a species on the SARA list. Of particular interest in these consultations is the identification of the benefits of adding each of the species to the list relative to the potential impacts on these species and on society of not adding them [7].

SARA is now fully implemented and has been effective since 2004 but the Species at Risk process continues to be controversial. In April 2009, the David Suzuki Foundation, in partnership with Ecojustice, Environmental Defence and Nature Canada, produced a five year report card. In this they graded SARA's listing practices, recovery strategies,

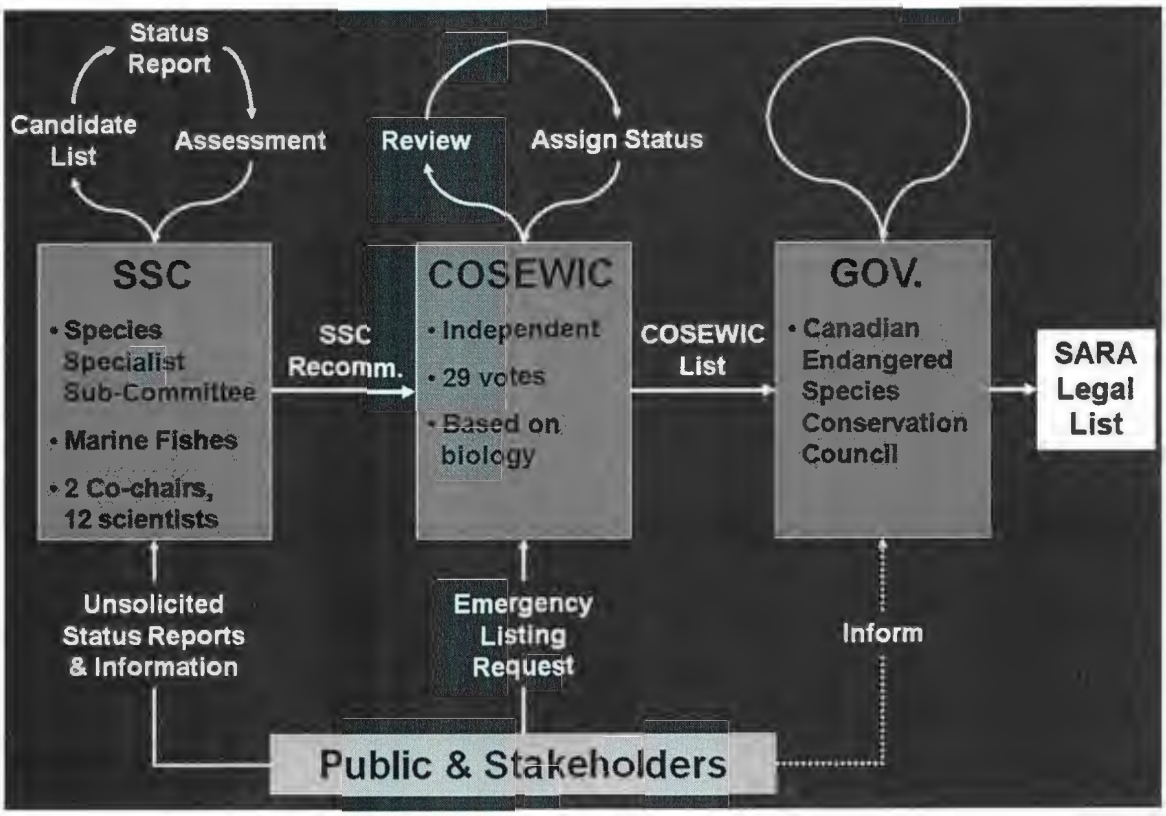

Figure 4.1: Overview of the listing process for COSEWIC and SARA [8].

action planning, and habitat protection for species at risk. SARA received an overall grade of F. They reported that "chances of eventual listing have been fairly good for most species - with the exception of species found in the oceans or in northern Canada" [15].

Conversely, in the fishing industry there are some who distrust the science used by COSEWIC as well as the conclusions of its members, and who feel that the legislative power of SARA is too strong. This was evidenced most recently in the Newfoundland and Labrador industry, government, and union responses to recommendations from COSEWIC to list Atlantic cod stocks as endangered or threatened in Canada. In 2005, COSEWIC recommended that cod be listed under SARA. This triggered a public outcry, with the result being a recommendation from DFO that they not be listed. This decision was endorsed by fishing companies, the Newfoundland and Labrador Fish, Food, and Allied Workers (FFAW) union and the NL provincial government [16]. It was the opinion of the union at that time that the federal government should remove aquatic species from the species at risk process because they were already being monitored by DFO [16]. An assessment by COSEWIC of five Atlantic cod populations in waters around Newfoundland in 2010 recommended an endangered listing for all five. As evidenced in related media coverage, this recommendation produced similar responses on the part of the FFAW and provincial Department of Fisheries and Aquaculture; "fishermen are irate. The provincial Fisheries Minister says stocks are improving, thereby justifying the existing levels of fishing. The Fish, Food and Allied Workers (FFAW) Union calls the committee report 'political science', 'misleading', and 'nonsense'." [17].

While marine fish have been evaluated by COSEWIC since it was established, three species of wolffish, the Atlantic (*Anarhichas lupus*), Spotted (*A. minor*), and Northern (*A. denticulatus*), have the distinction of being the only fully marine Atlantic Canadian fish to be listed federally. No fully marine Atlantic Canadian fish species has been listed after undergoing a full SARA review; when SARA was implemented in 2003, these three species of wolffish, along with the other species on the COSEWIC list, were grandfathered in and listed under SARA Schedule 1 [7]. Most other marine species, such

as the porbeagle shark and the northern cod, have been excluded from the list by the Minister due to social and economic considerations [18].

This paper draws on results from a multi-method case study of the wolffish listing process and outcomes to compare stakeholder opinions on the wolffish listing process and draw suggestions for future improvements to the listing process for marine fishes. It explores key elements and changes in the listing process associated with the implementation of SARA, changes in harvesters' involvement with the pre- and post-listing of marine fish, and western Newfoundland harvesters' and others' thoughts on wolffish delisting. It draws on data from interviews with key informants familiar with the listing of wolffish both by COSEWIC and under SARA, an analysis of documents and publications related to the wolffish listing and implementation of SARA, as well as existing research on the SARA process. It also incorporates insights from semi-structured Local Ecological Knowledge (LEK) interviews completed with 21 expert harvesters with an average of 28 years of fishing experience in area 4R on the west coast of Newfoundland in the Northern Gulf of St. Lawrence and dockside dialogues with harvesters.

4.3 Methods

4.3.1 Key Informant Interviews

A consent form, detailing the researchers involved with the project, the funders, community partners, the goals of this and the larger Community-University Research for Recovery Alliance project (www.curra.ca) with which this wolffish study is affiliated, the confidentiality measures to be taken, the risks and benefits of the project and archival deposit forms was developed for this project (Appendix K), along with an interview schedule (Appendix L). These tools, along with a description of the proposed research, were submitted for approval to the Interdisciplinary Committee on Ethics in Human Research (ICEHR), at Memorial University. The research design was confirmed be in compliance with the Tricouncil ethics policy and the ICEHR approved the research.

Following ICEHR approval we used four sources including the recovery plan for the northern and spotted wolffish [19], the SARA public registry [7], and suggestions from two members of COSEWIC at the time of the listing, to compile a preliminary list of 13 names of people who had been part of the wolffish listing, post-listing, or related SARA processes. This list included representatives from the COSEWIC marine fish subcommittee and from COSEWIC itself at the time wolffish were considered for listing. Once the list was compiled, these individuals were contacted by email. The email introduced the researchers and the research, and explained that they had been identified as someone who was involved with the wolffish listing process and/or had been part of follow-up activities since the listing. They were asked if they would be interested in doing a phone or face-to-face interview about their experience with the listing process, their observations on what has happened since, and the merits and possibility of wolffish delisting in the future.

Between April and September 2009, eleven individuals were successfully contacted and, of these, seven agreed to be interviewed. When individuals agreed they emailed back the signed consent form. In the consent form, they were also offered the opportunity to review and comment on a draft final report and to receive a copy of the transcript of their interview.

Five of the participating key informants were interviewed over the phone and two participated in face-to-face interviews. For each interview there were two researchers present. Interviews were not audio-recorded but detailed notes were taken during the interview. The key informants were first asked about their involvement with the listing process including how they got involved and their role. They were asked for their comments on the process and what involvement harvesters had in the process. Next, they were asked about the listing of marine fishes in general and the data used for listings. Key informants were also asked about their knowledge and perceptions of the status of wolffish in the Northern Gulf of St. Lawrence. Finally, they were asked about the potential delisting of marine species, what a wolffish stock recovery would look like,

what it would take to achieve it, and the merits and problems associated with the potential future delisting of wolffish.

Of the seven key informants who were interviewed three were involved with the wolffish listing under COSEWIC, two with SARA, and two with post-listing activities. Interviews ranged from 0:30 minutes to 2:20 hours (mean = 1:19 ± 0:36)

After each interview, the note were assigned a key informant interview number, dated, and the initials of the interviewers were added. A master list containing names and contact information for key informants and the corresponding interview number was developed and is stored separately from the interview notes in a password protected file. After the interview notes were cleaned up they were sent to the key informants for final adjustments and sign off.

4.3.2 Harvester Interviews

Twenty-one local expert fish harvesters were interviewed face-to-face during July and August 2009. These interviews were completed in communities along the west coast of Newfoundland, spanning from Rose Blanche to St. Paul's (Figure 4.1). Expert harvesters are defined in this study as individuals recommended by at least two sources (generally a representative of the Fish Food and Allied Workers Union which represents harvesters in much of Newfoundland and Labrador, Canada and by other harvesters). Harvesters were also asked for additional names of people who, in their opinion, would be good to interview. All additional names offered were already on the list of harvesters given by the FFAW; no new names came up. See Dawe (2010) for harvester sample results. Interviews were done one-on-one with a researcher (Dawe) and assistant present.

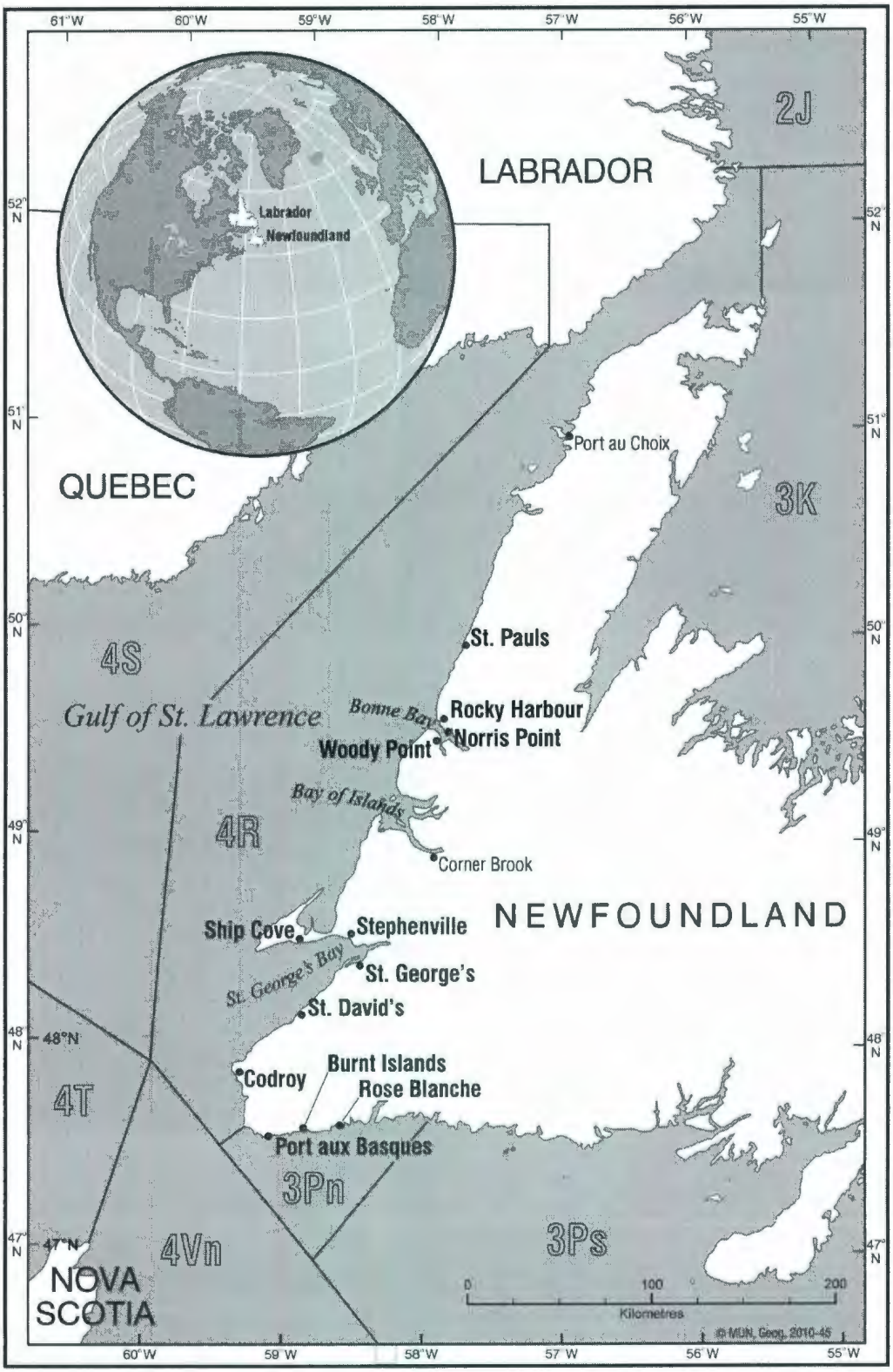

Figure 4.2: Map of the locations of harvester interviews. NAFO divisions 3Pn4R.

Harvesters were first asked to provide some basic background information including information about their age, training, and fishing careers. They were asked to identify the species of wolffish they had seen in their fishing career and then asked to discuss their fishing history including species targeted, gear specifications, trends in catches, wolffish characteristics, and fishing ground characteristics. Harvesters were asked to talk about wolffish biology, abundance, and distribution on their grounds. Finally, they were asked about their views on the listing of wolffish and their experiences with wolffish and with related conservation measures in their area since the listing. The responses to this last set of questions are the central focus of this chapter.

Interviews were audio-recorded and transcribed. During preliminary analysis of the transcripts, excerpts were broken down based on the following broad categories: demographics, fishing history, listing opinions and conservation. The information in the interviews was coded into a series of finer categories, the categories were used to create a spreadsheet database and quotes were inserted into the relevant field or category.

4.4 Results and Discussion

4.4.1 Workings of the Wolffish Listing

The Atlantic wolffish was the first of the three species of wolffish to be introduced to COSEWIC for review in 2000. The marine fish species subcommittee in COSEWIC reviewed the species status report and suggested that Atlantic wolffish be listed as Threatened. This status report and recommendation was then sent to the main voting body of COSEWIC. After much deliberation Atlantic wolffish was listed as a species of Special Concern in 2000. Of the three species, it was the most widespread and abundant in Atlantic Canada. The stock status report was authored by O'Dea, a student at Memorial University of Newfoundland and Labrador, and Haedrich [20] and was based on O'Dea's honours thesis. The report used data from DFO research vessel surveys conducted in waters around Newfoundland and Labrador between 1978 and 1994. Analysis of these

data showed an 87 percent decrease in population size and range for all waters around Newfoundland and Labrador and the Scotian Shelf (Appendix A).

The spotted and northern wolffish listings were held back until 2001. Two separate reports for the spotted and northern wolffish were put together by the same student [21-22] and used the same dataset. Results indicated a decline of 96 percent for the spotted wolffish and 98 percent for the northern wolffish for all waters around Newfoundland and Labrador and the Scotian Shelf (Appendix A). These assessments went through the voting process faster than the Atlantic wolffish.

> **KI**: In [2001] we brought up the two other wolffish, which had declined even more than the [Atlantic], listed as Special Concern. In the discussions many of the same arguments were brought up ... but the total committee didn't want to fool around anymore, it had already been through one wolffish.
> (Key informant interview #5)

The marine fish species subcommittee recommended to the main voting body of COSEWIC that northern and spotted wolffish be listed as Endangered, but the voting body of COSEWIC voted to list both as Threatened, based on life history characteristics that would make them less susceptible to extinction.

Key informants indicated that some COSEWIC committee members were critical of the wolffish status reports and thus of the recommendations. There were concerns among some about the report being based on a student's honours thesis rather than work by senior scientists. Some argued that the report was based on very limited data and only some of the available data was used. Also, trend lines in the data for all three species started in 1978, which may have been a peak year for wolffish abundance, thereby potentially exaggerating the extent of the decline in abundance for all three species. Other concerns related to changes in DFO research vessel data, such as changes in gear or census methods that might have influenced the trends in the data. One member of COSEWIC suspected that the decision to review the status of wolffish and the recommendation to list the three species was part of a larger strategy to test the waters

before introducing more controversial commercial species like Atlantic cod into the process.

> **KI**: For the Atlantic wolffish there was a directed fishery, the other two bycatch. One of these was used as a test case, which is my opinion. Caught as bycatch and the numbers have gone way down ... wanted to put [wolffish] on the table and see if we could get a majority to say that we can list a marine teleost ... have the camel's nose into the tent.
> **Q**: *Into cod?*
> **KI**: Yes. This was in my opinion the way the wolffish listing went.
> (Key Informant interview #3)

4.4.2 Listing process Pre- and Post-SARA

Prior to the implementation of SARA in 2003, a species listing under COSEWIC had no legal ramifications in Canada; the list appeared as public documentation only [3-4]. While species listed under COSEWIC were usually granted special considerations by provincial and territorial governments [3, 23], no such considerations were given to wolffish by DFO. There were no consequences for the fishery or stakeholders if the species were harmed as a result of the COSEWIC listings in 2000 and 2001. This changed with the implementation of SARA in 2003.

SARA brought stakeholders and the wider public into the listing process. Members of the species subcommittees and the voting body of COSEWIC assess potential species at risk, using the best available science to create a listing. If the Minister of Environment accepts a Threatened, Endangered, or Extirpated listing of a marine fish species, legal protection is immediately established [1]. This has immediate consequences for any fisheries and fish harvesters that potentially catch a listed species. When COSEWIC gives a listing recommendation to the CESCC and the Minister of the Environment, the latter is required to do a socioeconomic analysis of the potential impacts involving public and stakeholder consultations, prior to accepting the recommendation [24].

> **KI**: Where all of this got complicated was when SARA was made into law, because then COSEWIC would determine the scientific status and make a recommendation to the minister based on that. The committee is the one that makes the scientific recommendation, the Minister makes the policy recommendation. (Key informant interview #3)

There is a great deal of flexibility built into SARA regarding allowances for the capturing and live release of species at risk. In the case of wolffish, which are caught as bycatch in most North Atlantic fisheries, this flexibility has come in the form of a determination of allowable harm document through DFO, which states that northern and spotted wolffish must be released from gear [25]

When asked about changes in the COSEWIC process post-SARA, key informants consistently reported that the process had become more legalistic. The process became more formal with more rigorous reviews of species status reports and the scientific data used for the assessments. New dimensions, such as spatial scale and genetics, were increasingly considered for each species.

Some key informants reported that problems with the SARA listing process have surfaced since its implementation. There have been delays in the timing of species at risk listings under SARA. These occur during the time the Minister is reviewing a potential listing. The Minister may hold on to the status report or listing for a time, or send it back to COSEWIC for further analysis [23, 26]. These delays have potentially detrimental consequences for species at risk as they may not receive timely legal protection. There is also an issue with the collection of sufficient scientific data for a listing under SARA. In order to list a species under SARA there has to be a previous scientific work completed for the species that shows trends in population size and range, and life history traits for the species. Only when these data are analyzed can a recommendation go forth. A listing under SARA results in an allocation of funds towards increased scientific research. Unfortunately, for many species there is a lack of previous work to justify a listing and no funding to do so.

While some key informants reported disliking the new process and climate, citing increased pressure on scientists and the threat of legal action in response to improper scientific assessments, others welcomed the change.

Despite their reservations, some key informants familiar with the process pre- and post-SARA reported that the strength and credibility of the status assessments had increased since 2003.

> **KI**: If the assessment by COSEWIC is not fully supported by the status report, then it justifiably raises questions about the credibility of the assessment. I think over time the reports are increasingly credible, reviewed better and more extensively and that as a general rule the reports are better … that doesn't mean the assessments prior to SARA were scientifically suspect or deficient in some way. (Key Informant interview #7)

Others thought the stronger scientific requirements and the threat of legal suits are among the reasons why no more marine fish have been listed since 2003.

> **KI**: I don't think that any marine fish have been added to Canada's official list of endangered species since SARA was put in place because the Minister did what he was allowed to do under the law and that was to send the report back to COSEWIC for reconsideration and new data. The Minister of Fisheries has a veto power for aquatic species. (Key informant interview #5)

The key informant interviews showed that when wolffish were placed on SARA's Schedule 1 in 2003 very few people were involved with the process and few were informed about it, or about the objectives or process of SARA itself. When asked where they had first heard of the listing of wolffish, the majority of harvesters interviewed reported that they had originally found out through meetings and information included in their licence papers from DFO (n=12) after the 2003 SARA listing. Others reported finding out through the FFAW (n=5); only two reported hearing about it on the news.

4.4.3 Post-listing Activities and the Listing of Other Marine Fishes

The lack of awareness of SARA, among both harvesters and the general public, spurred the coordinators of the Act to use the wolffish listing as a way to help stakeholder groups in marine fisheries, including fish harvesters, become aware of SARA.

> **KI**: We had to present this decision, present SARA, and what SARA stood for; it had not been declared at that time, it had not become the law of the land. [We had to] prepare to make SARA known, particularly to the fishing community, and to explain why the wolffish had been listed, why it had been selected, why it was considered a species of special concern or threatened. (Key informant interview #1)

Considerable resources have been invested in wolffish science and management since the three species were listed under SARA. There has been widespread publicity about the listing and about wolffish; harvesters have been educated in ways to return live wolffish to the water without harming themselves or the fish. SARA coordinators, DFO, and the FFAW union have participated in meetings, supported the development of information cards and posters, training on release methods (Marine Institure-MUN, DFO, FFAW) was provided to some large fishing company crews, and a wolffish stewardship DVD [27] was created by Intervale Associates with a grant from the Government of Canada Habitat Stewardship Program for species at risk. A recovery plan has been developed [19] and there has been more dedicated wolffish scientific research [28-31].

By examining which methods of education and publicity have been most effective, conservation methods can evolve for future listings. Many harvesters stated that the increased education that came with post-listing conservation projects has increased their knowledge of wolffish; many have come out with a better appreciation for the species and for the Act.

The increased knowledge and appreciation of SARA is an improvement from 2003 when the listing became public knowledge. Harvesters were taken by surprise by the increased regulations. Wolffish were a "rather obscure fish, not much fished" (Key informant interview #5). When asked about their opinions on the wolffish listing today, harvesters reported that they agree with the listing of northern and spotted wolffish (n= 12), but not with the Atlantic wolffish listing (n=14). Nine harvesters were neutral on the listing of northern and spotted wolffish, and seven were neutral on the Atlantic wolffish listing.

While there are members of the federal government who agree with the listing of wolffish, there are some members who hold the opinion that there is no need to list wolffish, or to even look at marine fishes in general from a species at risk point of view. For both commercial and non-commercial species, they argue there is a federal agency, DFO, in charge of managing marine fish populations and ranges. In addition, there is doubt that the current species at risk system can work to protect marine populations. This stems from the idea that the proxy criteria for listing a species, taken from IUCN guidelines, do not encompass marine fish species:

> **KI**: There will be a large segment of opinion that says that these criteria do not capture marine fish species ... can't apply the proxy criteria to marine fish species because they don't behave that way. ... My opinion tends to agree with the idea that marine fishery species are outside the mandate of COSEWIC. (Key informant interview #3)

On the other side there is the opinion that this argument doesn't stand up.

> **KI**: If parliament felt that the fisheries act and the oceans act were sufficient legislative tools for recovery of marine fish parliament will have excluded marine fish- the fact SARA includes all of these species is testimony to the fact they didn't think that. (Key informant interview #7)

This key informant states that the idea that marine fish have a lower extinction probability than other taxa, due to their higher levels of abundance, broad distributions, high levels of offspring produced, and perceived resilience to anthropogenic disturbance, has no evidence to support it [23].

The IUCN criteria are not used strictly in the case of marine fishes, but rather as guidelines. The main criterion for marine fish is the rate of population decline [23] though, due in some cases to large population sizes, other factors, such as life history attributes, are also taken into account. In the case of the wolffish listing, this was the reason why the status of all three species was lowered from Endangered to Threatened for northern and spotted, and Threatened to Special Concern for Atlantic by COSEWIC. Though population numbers had decreased dramatically, some members of the voting body of COSEWIC felt that wolffish life history traits, such as fecundity and population resilience, warranted a lower rating as these traits would help the species recover at a much more rapid rate.

4.4.4 Harvesters in the Listing Process

At the time of the wolffish listing under COSEWIC there was no framework in place to collect and assess harvesters' LEK, giving fish harvesters in Newfoundland no chance to include their knowledge of wolffish into the species status report. The later addition of wolffish to SARA in 2003 when the legislation was still relatively weak meant that no public and stakeholder consultations took place. Harvesters therefore had no meaningful involvement with the listing process.

Based on harvester interviews on Newfoundland's west coast, harvester LEK appeared to diverge from trends emerging from fisheries science data from the entire range of wolffish, the basis for fisheries science and the listing. Many harvesters around the island did not see the severe decrease recorded by DFO in all local wolffish populations. In inshore waters where stock assessment research is lacking, harvesters reported in

interviews that populations have not decreased heavily. When comparing present catch rates to past catch rates, out of 21 interviews, seven harvesters reported no change and 12 reported increased catch rates of *A. lupus* over their careers (mean = 28 years). Three harvesters from Bay of Islands to St. Paul's reported reduced numbers in their catches for *A. denticulatus* and *A. minor*.

The divergence between harvester LEK and fisheries science on wolffish does not seem to have resulted in a backlash, among harvesters, against the listing. One reason for this may be that the listing has had little negative impact on fish harvesters. For harvesters in Newfoundland and Labrador only two of the three species were landed and sold as bycatch; there is no directed fishery for wolffish. Wolffish were not species of consequence.

Though there is little resentment from harvesters for the wolffish listing there remain potential risks for harvesters who take spotted and northern wolffish incidentally. While Atlantic wolffish can be caught (up to 200lbs or 10% of a harvester's daily catch), the Threatened designation of the other two species results in legal consequences for harvesters who are found to have these species onboard. In April 2010 a harvester in Newfoundland was fined $5,000 for possessing two spotted wolffish [32] due to the inexperience of his crew in visually identifying the individual species. Future prosecutions such as this may sway harvester opinion against the listing.

Since the wolffish listing there has been a greater push to include harvester LEK in the COSEWIC and SARA processes of assessment and listing, especially with regards post-listing conservation activities. The main tool for wolffish conservation to date has been the use of live release methods for wolffish survival in fisheries that they are caught in as bycatch [30]. The live release methods came from consultations and onboard observations with harvesters who provided scientists with methods to reduce the impact on live populations and thus drew upon their local knowledge.

4.4.5 Future Delisting of Wolffish

The recovery of a species at risk is arguably the most important goal of species conservation legislation. Within SARA, the recovery of a species results in the removal of the species from the national list, or delisting. Recovery implies that population numbers have increased, ranges have expanded, and critical habitat is sufficiently protected to ensure a species is no longer at risk. Acceptable population increase, range expansion, or critical habitat protection are determined in the recovery plan of a species, and are unique to each species. Recovery plans have to be completed within five years of a species being placed on SARA. To date there has been little work done on delisting terrestrial species listed under SARA and no work done with regards to marine species [23]. This problem is compounded by a lack of recovery plans completed for species at risk on time, and therefore a lack of criteria established for delisting.

Delisting criteria for a species at risk must include clear cut requirements, such as a population threshold or range expansion, and a timeline for these requirements. Some key informants reported that these requirements are not as extensive as they could be. They suggested that recovery goals should not only focus on population size or distribution but should also look at the entire habitat and a species' life history traits, such as fecundity and biology.

> **Q**: What would a recovery of wolffish look like?
> **KI**: I think it would have to include a look at use of the area where the wolffish are found...population numbers, ages found now, where is the distribution taking place, location sites, and the use of these location sites. (Key informant interview #1)

No delisting requirements or timelines were laid out in the wolffish recovery plan, *Recovery Strategy for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor), and Management Plan for Atlantic Wolffish (Anarhichas lupus) in Canada*, in part due to a lack of scientific data. There have been no studies on wolffish

recruitment or age classes currently in waters around Newfoundland and Labrador. Without these data it is impossible to establish concrete guidelines for recovery.

Recently, the issue of delisting a species prematurely has been raised in the case of wolffish. Key informants reported a push from the Fisheries Resource Conservation Council (FRCC) to delist wolffish. If wolffish were to be delisted before a full recovery had taken place, or the data were accurate it could potentially lead to a second population crash.

> **KI**: The biggest problem would be if it were de-listed before it should be if the data were not accurate, well-done, etc. My hope is that the knowledge that is required will be there. If not, it will just spiral down again and it will be more difficult the second time around. (Key informant interview #1)

A delisting needs to be an open, transparent, credible process for scientists, government, and harvesters. This would require planning and open discussion but it appears as though nothing has been done in this area to date.

Delisting, to be workable, has to be in reference to the decline that brought about the species at risk listing. One issue is listing an entire species when declines have not occurred throughout the species range. If data show no decline in part of the range, or in a definable population, then should the listing for the species apply in that range or that population? For wolffish, the listing was based on a large area. Analysis of fisheries science data and harvester LEK shows that, in the northern Gulf of St. Lawrence, the pattern of decline seen does not match the decline used in making the listing for the species [33]. Catch per unit effort data for the Gulf of St. Lawrence shows that catch rates have declined sufficiently for all three species to warrant the Special Concern and Threatened listings, but these declines were based off low catch rates and potential peaks in population sizes. Unfortunately, there is no evidence of specific populations or individual gene pools for either of the three species of wolffish in North Atlantic waters [28]. In the absence of identifiable populations, recovery targets must remain large scale.

4.5 Conclusion

Since its creation in 2003, Canada's Species at Risk Act has been an evolving process for the government, scientists, and stakeholders alike. While past analyses have focused on the Act from a regulatory point of view, there has been no examination of the impact the process has on stakeholders, such as fish harvesters, for listed aquatic species. This paper shows that there are many lessons that can be taken from a case study of the wolffish listing from the point of view of those involved with the process and the viewpoint of harvesters affected by the listing.

The first lesson that becomes apparent is the uniqueness of the wolffish listing. Future listings of marine fishes will not occur in the same way and with the same limitations in scientific data as happened with the wolffish listing. With the implementation and legal force of SARA there are increased demands on the science that a listing is based on. The wolffish listing under COSEWIC was based on limited data from offshore waters and limited behavioural data. For a higher profile species, such as Atlantic cod, scientific data must be more thorough to warrant a listing under SARA and even then, cod may not be listed and have not been listed for socio-economic reasons [17].

Though implementation of the SARA legislation was a pivotal step in the protection of species at risk, it is not clear that, in its current form, it is an adequate tool for protecting marine fish species at risk. Delays in decisions by the Minister have led to a standstill in the process and a potential loophole for the timely listing of species at risk [26]. The absence of a means to systematically collect and assess LEK within the SARA process means that stakeholder consultations required under SARA generally come down to public opinion fuelled by political pressure. Finally, there is a catch-22 in the process when it comes to collection of scientific data. Unlike the listing process under the ESA, which allows for the allocation of funds for the review and gathering of scientific data, a species has to be listed under SARA before a majority of the funds available can be allocated.

Unquestioning acceptance of public opinion as LEK can lead to the inclusion of stakeholders with personal and political agendas in the listing process. While it is important to include all beneficial information into the process, it is important to avoid endless debate. The ongoing controversy over the assessment of marine fishes shows issues with the cohesiveness of the process. A symmetrical treatment of both scientific and local knowledge is needed in order to use LEK to its fullest extent in the species at risk process. Claims about LEK need to be supported with data. Symmetrical treatment would require that there be some resources to systematically collect LEK. Chapter 3 makes the case that, with criteria in place to assemble and apply LEK, stakeholder consultations can, in some cases, strengthen species status reports, thereby strengthening the SARA process. However, the current process puts LEK at a disadvantage because it equates LEK with any claims fishermen or representatives might make in a meeting, encouraging the perception that LEK is thinly veiled self interest dressed up as knowledge. Symmetrical treatment of LEK and the implementation of a systematic collection strategy for LEK would require some amendments to the SARA process.

To date little attention has been paid to delisting of species at risk, which is arguably the most important goal of species conservation. Without delisting requirements or timelines set up in a species recovery plan it is impossible to establish concrete guidelines for recovery.

Finally, there is evidence in this research of value in the wolffish listing process. The increase in stewardship and the engagement of harvesters in the SARA process has stemmed from the introduction of SARA and wolffish by coordinators into communities in Newfoundland. These will be important stepping stones for future listing of marine fishes and for future harvester involvement.

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5. Evaluation of harvester LEK, fisheries stock assessment data, and key informant interviews for the wolffish listing under the Species at Risk Act

This chapter will bring together the results and conclusions of the previous chapters. This multi-method study used an analysis of stock assessment data for the Northern Gulf of St. Lawrence, supplemented by on-board observation and semi-structured interviews with Northern Gulf fish harvesters. These data were used to compare knowledge on wolffish biology, biogeography, and population trends. This study also documented commercial harvesters' Local Ecological Knowledge (LEK) in area 4R to see whether there are ways it might be able to contribute to augment the scientific information available for evaluating stock status and for understanding harvester response to and engagement with the species at risk process. In addition it used a review of existing documents and key informant interviews to understand how wolffish came to be listed, to capture the perspectives of a diverse set of stakeholders on the listing process, and on de-listing.

5.1. Comparing Fish Harvesters Knowledge and Scientific Stock Assessment Data

Harvester reports of wolffish biology in the Northern Gulf of St. Lawrence were concurrent on several aspects with published literature from Newfoundland and Labrador and Northeast European waters, stock assessment data from Newfoundland, mobile sentinel data from the Northern Gulf, and onboard observations from the Northern Gulf. Harvesters reported observations on wolffish biology, abundance trends, and biogeography from their fisheries.

Results from LEK interviews and onboard observations on wolffish life history showed how harvesters visually identify wolffish in the field using the same methods as those for scientific studies. Harvesters reported the opportunistic nature of wolffish feeding. They reported wolffish being caught in lobster pots, crab pots, and on longlines going after bait fish, though for the more inshore species *A. lupus* and *A. minor*, fish is a very small proportion of their diet. In the LEK interviews harvesters also reported seasonal

distributional changes of wolffish over the course of their fishing seasons (April to September). They reported when in the fishing season wolffish were first found in their gears and when they seemed to 'disappear'. These trends correspond with wolffish reproduction seasons. Offshore stock assessments are unable to pick up these trends due to the different spatial and narrow temporal nature of the surveys. In addition there have been few published findings on seasonal trends.

Results from abundance trends and biogeography in harvester interviews, along with onboard observation, stock assessment data from research vessel data, and mobile Sentinel data show that the range for all three species in the Northern Gulf of St. Lawrence does not go further north than Port aux Choix. This can be attributed to the influence the Labrador Current has on the waters of the Strait of Belle Isle. Wolffish are restricted to the warmer waters further south of the Gulf. Harvesters also reported that the majority of wolffish caught in inshore fisheries were adults (>55 cm). In contrast, juveniles were mainly caught in offshore mobile Sentinel surveys. This difference can be explained by a separation by depth of adults and juveniles during summer months, or by offshore sampling methods.

The concurrence of these observations, the lack of major inconsistencies, and the degree of complementarity show that science and LEK can be used conjointly in the area. This study shows that, for future assessment and monitoring of marine species at risk, LEK and science can be used conjointly to examine a species. The spatial and temporal scales of LEK and science do not completely overlap, but can be used together to examine a broader range of both scales.

5.2. The Functionality of the Listing Process and Implications for Newfoundland Fishers

Chapter 4 draws on interviews with key informants familiar with the listing of wolffish both by COSEWIC and SARA, an analysis of existing documents and research on the SARA process, and local ecological knowledge (LEK) interviews completed with expert harvesters in the Northern Gulf of St. Lawrence. Results show that there are many lessons that can be taken from a case study of the wolffish listing from the point of view of those involved with the process and the viewpoint of harvesters affected by the listing and from the point of view of the necessity for a clear route to delisting.

The listing process for the three North Atlantic wolffish under SARA was unique for marine fishes in Canada; future listings will not occur in the same way. The data necessary for a listing today must be more thorough than that for wolffish. There is evidence that the listing itself has resulted in an increase in harvester involvement and stewardship, as well as an increase in knowledge about SARA. Increased harvester involvement is essential for future listings of marine fishes.

There remain issues with the SARA process, including delays in decision and submission on species at risk assessments, the listing of marine fishes, the absence of a means to collect and assess LEK, and with the collection of scientific data for potential species at risk. These issues have hampered SARA's ability to protect potentially at risk species, which could lead to detrimental consequences.

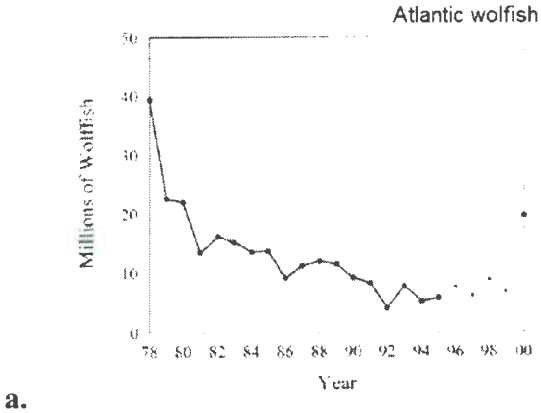
Finally, to date little attention has been paid to delisting of species at risk. A delisting represents a recovery for a species listed under SARA. While this is arguably the most important goal of species at risk conservation, little to no work has been done to determine guidelines for determining what an acceptable recovery would be. Without delisting requirements or timelines set up in a species recovery plan it is impossible to establish concrete guidelines for recovery.

5.3. Future Work

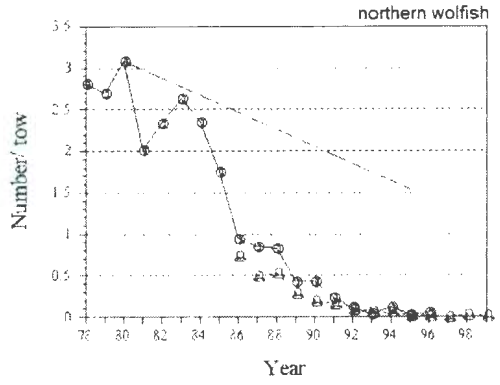
Future scientific studies should further investigate wolffish biology and abundance trends in the field with help from harvesters. Specifically, future studies should centre around:

1. Continuation of interview and feedback sessions builds trust and capacity for communication.
2. Inshore sampling of wolffish using catch and release methods or telemetry from April to September to track seasonal changes. Working with harvesters who already know when wolffish appear and disappear in their gears gives a starting point for research. Knowledge of seasonal distributions may give areas for protection during the fishing season.
3. Inshore and offshore sampling with nets of a range of mesh sizes to determine length and size frequencies would help get a better understanding of size distributions.
4. A continuation of interviews with key informants involved in the COSEWIC and SARA listing process to more extensively examine the process of listing for future listings of marine fishes.

Appendix A: Decline of a. population size; b and c. CPUE of three wolffish species in Newfoundland based off RV data from Newfoundland waters only. In all graphs, the straight/dashed line above is the COSEWIC endangered criterion for each species (50% decline). (O'Dea and Haedrich 2000; O'Dea and Haedrich 2001a; O'Dea and Haedrich 2001b)



a.



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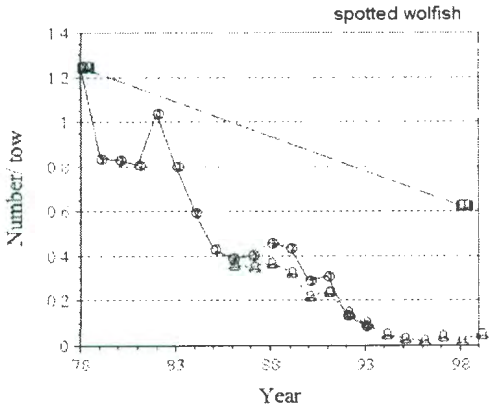

c.

Appendix B
PARTICIPANT CONSENT FORM FOR OBSERVATION ON-BOARD FISHING VESSELS

I am a graduate student at Memorial University. This research is a part of my Master's project. The research is part of the CURRA (Community-University Research for Recovery Alliance) initiative. CURRA is funded by funded by the Social Sciences and Humanities Research Council in Ottawa and involves researchers in both the natural and social sciences from Memorial University. A number of community partners are also involved with the CURRA project. These partners included the Fish Food and Allied Workers Union, the Department of Fisheries and Oceans, Intervale Associates (Kathleen Blanchard) and the Integrated Coastal Zone Management Initiative.

The purpose of the research is to learn more about wolffish in this region, to identify any lessons we can learn from the wolffish experience about the listing process, and ways to improve it.

The goals of my Masters research are:

1. to explore the things that led to the listing of three species of wolffish under the Species at Risk Act in the first place;
2. to find out more about what has happened since wolffish were listed and the consequences of the listing for local fish harvesters;
3. to learn more about wolffish in the Northern Gulf of St. Lawrence; and ,
4. to discuss with different groups the likelihood and pros and cons of a future de-listing.

For this part of the thesis, I am asking fish harvesters from the Northern Gulf of Newfoundland to volunteer to let me accompany them on one or more fishing trips to record the location and composition of wolffish by-catch on their grounds and any challenges harvesters might have dealing with this bycatch (risk of injury, etc.). The purpose of these observations is to supplement what I am learning from analysing the research vessel survey and observer data on wolffish and from interviews with expert fish harvesters.

If you consent to participate in this research, I will travel with you to your grounds and, using a GPS and information from you, record the depths and locations where you fish and the areas where you are catching wolffish. I will also ask you about any places where you used to see wolffish but no longer do and about variations you have observed in the distribution of wolffish and about when they are more and less likely to appear in your gear. I might also take notes on any conversations about wolffish we have while I am out in your boat as background to understanding this information.

Following this research, if you are interested in reviewing a draft copy of the resulting plain language report and in having a final copy, copies can either be mailed or emailed to you.

Participation in this part of the research is free and voluntary. You may refuse to participate or answer any specific question. You are also under no obligation to explain your answers and can leave the study in the future if you change your mind about participating. If you decide to leave the study, the notes taken during the trip will be destroyed.

The list of harvesters participating in this part of the research will be kept confidential and your name or vessel will not be used in any presentations reports or publications resulting from this research. That said, other harvesters from this area will know who I fished with.

Each interview will be assigned a number and the list of names, corresponding numbers and contact information will be kept in a separate, secure cabinet, away from the interview transcripts. The GPS coordinates of bycatch in your fishing grounds will be kept confidential and will only be published in combination with coordinates collected from other harvesters to hide the location of your grounds. Only the information on wolffish location will be used

We don't think there are any risks to you associated with allowing me to accompany you on one or two trips. As a student of Memorial University, I am covered by the University's insurance. I should indicate, however, that this insurance coverage will not be valid if I am injured helping you fish so unfortunately I will not be able to help out during the trip.

By participating in this project, you can contribute to the overall knowledge base for understanding and managing wolffish in the Northern Gulf.

PARTICIPANT CONSENT FORM FOR OBSERVATION ON-BOARD FISHING VESSELS

I have had the purposes of this research and the benefits and risks to me explained clearly ____ Yes/ ___ No

I realize my participation is voluntary and I am free to withdraw from this study at any time. ____ Yes/ ____ No

I hereby consent to participate in this study. ____ Yes/ ____ No

I would like an opportunity to review and comment on a draft final report from this study ____ Yes/ ____ No

I would like to receive a short summary of the study findings ____ Yes/ ____ No

If yes: my email address is _____

If no email: my regular mailing address is _____

_____	_____	_____
Name of participant	Signature of participant	Date
_____	_____	_____
Name of Researcher	Signature of Researcher	Date

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(709) 737-7244
Please feel free to contact her if you have any questions.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 737-8368.

PARTICIPANT CONSENT FORM FOR OBSERVATION ON-BOARD FISHING VESSELS

Third Party Witness (where necessary and available)

I have witnessed the researcher named below explain the research project and the contents of this consent form to the participant and I am satisfied that the participant understands the consent form and is aware of his/her rights with respect to participation in this interview.

_____	_____	_____
Name of 3rd Party Witness	Signature of 3rd Party Witness	Date

On behalf of Memorial University:

_____	_____	_____
Name	Signature	Date

ARCHIVAL DEPOSIT FORM

Once the research project is complete, it is up to you what is done with the interview notes. However, as part of the research integrity policy at Memorial University, interview materials must be kept in a secure location by the researchers for 5 years after completion of the master's thesis.

The information you provide may also be a valuable resource for other, future researchers. If you are willing to have a copy of the interview notes, field notes, and charts made available to other students and researchers from Memorial University, please indicate below. If you agree to deposit the interview tapes, transcript and charts for future use, please keep in mind that the list of names will remain confidential.

Therefore anyone using this resource would not be permitted to use your real name in any published document, public presentation, or any other publicly accessible media without your permission. You can also request that future researchers only have access to the interview tapes, transcript and charts with your written permission.

If you are uncomfortable with any of the above options, you may ask to have the interview notes, field notes, and charts retained only by the research team, or even destroyed after the completion of the project (i.e. 5 years after publication of results) required by Memorial.

Finally, you may wish to receive a copy of the interview tapes for your own personal records.

Please check your preferred options below.

I hereby authorize:

OPTION 1:_____	Placement of the interview notes, field notes, and charts in the Memorial University Folklore Archive at Memorial University. A. Access up to the discretion of the Archivist _____ B. Access only with my written permission_____
OPTION 2:_____	Retention and use of interview notes, field notes, and charts only by the research team
OPTION 3:_____	Destruction of the interview notes, field notes, and charts after the completion of the project and the required delay for research integrity.
OPTION 4:	Do you wish to have a copy of the interview notes and field notes sent to you? YES_____ NO_____

If yes, please provide your email address: _____

Name_____ Signature_____ Date_____

Signing of behalf of Memorial University:

Name_____ Signature_____ Date_____

Appendix C

PARTICIPANT CONSENT FORM FOR INTERVIEWS WITH LOCAL FISH HARVESTERS

I am a graduate student at Memorial University. This research is a part of my Master's project. The research is part of the CURRA (Community-University Research for Recovery Alliance) initiative. CURRA is funded by funded by the Social Sciences and Humanities Research Council in Ottawa and involves researchers in both the natural and social sciences from Memorial University. A number of community partners are also involved with the CURRA project. These partners included the Fish Food and Allied Workers Union, the Department of Fisheries and Oceans, Intervale Associates (Kathleen Blanchard) and the Integrated Coastal Zone Management Initiative.

The purpose of the research is to learn more about wolffish in this region, to identify any lessons we can learn from the wolffish experience about the listing process, and ways to improve it.

The goals of my Masters research are:

5. to explore the things that led to the listing of three species of wolffish under the Species at Risk Act in the first place;
6. to find out more about what has happened since wolffish were listed and the consequences of the listing for local fish harvesters;
7. to learn more about wolffish in the Northern Gulf of St. Lawrence; and ,
8. to discuss with different groups the likelihood and pros and cons of a future de-listing.

For this part of the thesis, I am interviewing expert active and recently retired harvesters with many years of experience fishing in the Northern Gulf. The purpose of these interviews is to gather any insights local harvesters can provide about the distribution and behavior of the three species of wolffish in the Northern Gulf of St. Lawrence, trends in abundance, and about the influence the listing of wolffish under the Species at Risk Act has had on local fishermen. I will use this information in combination with an analysis of DFO research vessel survey data and some on-board observations of wolffish with harvesters to improve our knowledge of wolffish in this region.

If you consent to participate in this interview, I will ask you a few questions about yourself- how long you have fished, education, etc. I will then ask you to tell me about your fisheries, when you started fishing fulltime, and about your observations of wolffish in those fisheries. I will ask you to help me locate your fishing grounds when you first started fishing, where you saw wolffish in your gear on those grounds and where you did not on a chart. I will then ask you about your fisheries in the last few seasons you fished, any changes in the fisheries, and your observations about wolffish on your fishing grounds in those fisheries. We will use the chart again for this piece of the interview. I will also ask you about your knowledge of the listing of wolffish under the Species at Risk Act, how this listing has affected you and other fishermen you know, your opinion

of the listing and your opinions on the importance of wolffish, the need to protect them and the best ways to achieve this protection in the future. Finally I will ask you for your opinions on wolffish conservation and stewardship activities.

Following this interview, if you are interested in reviewing a draft copy of the resulting plain language report and in having a final copy, copies can either be sent or emailed to you.

Participation in this interview is free and voluntary. You may refuse to participate, answer any specific question, or leave the interview at any point. You are also under no obligation to explain your answers or decisions and can leave the study in the future if you change your mind about participating. If you decide to leave the study, the recorded interview and chart(s) will be destroyed.

The list of people interviewed for this project will be kept confidential and your name will not be used in any presentations reports or publications resulting from this research. Each interview will be assigned a number and the list of names, corresponding numbers and contact information will be kept in a separate, secure cabinet, away from the interview transcripts. Individual charts showing your fishing grounds will not be published in any form. Instead, information on wolffish presence and absence at different points in your career will be used in reports and publications to develop wolffish abundance estimates that can be compared to RV data. Information on areas where wolffish have been observed will be brought together from all of the interviews and presented in a few maps showing the collective observations of all harvesters. The interview will last approximately 1 to 1 1/2 hours but the actual length will depend on how much you have to say.

You should be aware that a local community member or someone who knows you might suspect you provided a specific piece of information.

We don't think there are any risks to you associated with participating in this interview. By participating in this project, you can contribute to the overall knowledge base for understanding and managing wolffish in the Northern Gulf.

CONSENT FORM FOR INTERVIEWS WITH LOCAL FISH HARVESTERS

I have had the purposes of this research and the benefits and risks to me explained clearly ____ Yes/ ___ No

I realize my participation is voluntary and I am free to withdraw from this study at any time. If I withdraw the tapes, transcripts and charts for my interview will be destroyed. ____ Yes/ ____ No

I hereby consent to participate in this study. ____ Yes/ ____ No

I consent to the audio taping of this interview ____ Yes/ ____ No

I would like to be notified of feedback meetings near my community ____ Yes/ ____ No

I would like to receive a short plain language report on the study findings ____ Yes/ ____ No

If yes: my email address is _____

If no email: my regular mailing address is _____

_____	_____	_____
Name of participant	Signature of participant	Date
_____	_____	_____
Name of Researcher	Signature of Researcher	Date

This research is being supervised by:
Dr. Barbara Neis
Department of Sociology, Memorial University
bneis@mun.ca
(709) 737-7244
Please feel free to contact her if you have any questions.
The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 737-8368.

PARTICIPANT CONSENT FORM FOR INTERVIEWS WITH LOCAL FISH HARVESTERS

Third Party Witness (where necessary and available)

I have witnessed the researcher named below explain the research project and the contents of this consent form to the participant and I am satisfied that the participant understands the consent form and is aware of his/her rights with respect to participation in this interview.

_____	_____	_____
Name of 3rd Party Witness	Signature of 3rd Party Witness	Date

On behalf of Memorial University:

_____	_____	_____
Name	Signature	Date

This research is being supervised by:
Dr. Barbara Neis
Department of Sociology, Memorial University
bneis@mun.ca
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The information you provide may also be a valuable resource for other, future researchers. If you are willing to have a copy of the interview tapes, transcript and charts made available to other students and researchers from Memorial University, please indicate below. If you agree to deposit the interview tapes, transcript and charts for future use, please keep in mind that the list of names will remain confidential.

Therefore anyone using this resource would not be permitted to use your real name in any published document, public presentation, or any other publicly accessible media without your permission. You can also request that future researchers only have access to the interview tapes, transcript and charts with your written permission.

If you are uncomfortable with any of the above options, you may ask to have the interview tapes, transcript and charts retained only by the research team, or even destroyed after the completion of the project (i.e. 5 years after publication of results) required by Memorial.

Finally, you may wish to receive a copy of the interview tapes for your own personal records.

Please check your preferred options below.

I hereby authorize:

OPTION 1:_____ Placement of the interview tapes, transcript and charts in the Memorial University Folklore Archive at Memorial University.
C. Access up to the discretion of the Archivist _____
D. Access only with my written permission_____

OPTION 2:_____ Retention and use of tapes, transcript and charts only by the research team

OPTION 3:_____ Destruction of the tapes, transcript and charts after the completion of the project and the required delay for research integrity.

OPTION 4: Do you wish to have a copy of the interview tape sent to you?
YES_____ NO_____

If yes, please provide your email address: _____

Name_____ Signature_____ Date_____

Signing of behalf of Memorial University:

Name_____ Signature_____ Date_____

Appendix D
INTERVIEW PROTOCOL FOR LOCAL FISH HARVESTERS

First contact (Telephone)

Hi. My name is Jennifer Dawe. I am a researcher at Memorial University working with the Community-University Research for Recovery Alliance, an initiative funded by the Social Sciences and Humanities Research Council in Ottawa. I am doing research on wolffish for my Masters thesis. As you may know, four species of wolffish have recently been listed in Canada and three of these are very common around Newfoundland.

A portion of my research project deals with wolffish in the Northern Gulf. For this portion I am analyzing DFO data on trends in abundance and wolffish distribution in this region. I am also gathering the local knowledge of expert harvesters with a long history of fishing in the Northern Gulf.

You have been identified as someone who is very knowledgeable about the fisheries in your area and who has a long history of involvement in those fisheries. I am contacting your today to see if you would be willing to do a face-to-face interview with me about those fisheries and more specifically about your observations and experience with wolffish. I also want to talk to you about the listing of wolffish under the Species at Risk Act and your experience with and knowledge of any recovery programs that have been introduced. Finally, I want to talk to you about any thoughts you might have about whether and how wolffish might be de-listed in the future and on the overall species at risk process.

If you decide to consent to an interview, it should take approximately 1.5 hours of your time, but the length will vary depending on how much you have to say.

Participation in this research is free and voluntary. Should you agree to participate, your name will not be used in any publications or reports from this research and quotes or specific information will not be linked to you in any way. You will be free to refuse to answer particular questions and to withdraw from the study at any time. Would you be interested in participating? If yes, when would be a good time for us to meet?

Interview Schedule

Ethics

- Review the consent and archival deposit form reading/explaining what each paragraph means. Ask if they would like to read it through or, if they seem uncomfortable, if they would like someone to go over the form with them. If they indicate yes, and there is a third party present, have them read it. If there is no third party present then read the forms to them, pausing to make sure each section is understood.
- Explain that participation in the interview is completely voluntary. If they agree to be interviewed, explain to them that they have the right to decline to answer any question without justification and that they have the right to withdraw from the research at any time. Should they withdraw, the recorded interview will be destroyed.
- Ask them to sign in appropriate places and check off appropriate selections for archival deposit. Their signature indicates that he/she understands what the research is about, that their participation is completely voluntary, and that they are consenting to being interviewed. Interviewer also signs on behalf of Memorial University. Leave signed copies of consent and archival deposit forms with them.
- We are interested in getting feedback on the results of this research. Would you be interested in commenting on a draft final report for this study? Results will also be presented in a feedback meeting with harvesters in this area. If they are willing to comment on the draft report ask for a mailing address or email address and record it on the consent form indicating that they are willing to review a draft report.
- A final report will be posted to the CURRA website which can be accessed through the Bonne Bay Marine Station website at http://www.bonnebay.ca/
- Would you like us to send you a copy of the final report? If yes, record their mailing address on the consent form or email.

[Take out laptop and software and explain how it works and when it will be used]

Thanks again for agreeing to participate in this interview. The first part of the interview has a few questions about your background and fishing experience.

- Age_____
- Gender: M_____ F_____
- Education level: <Grade 8_____Grades 9-11_____ Graduated High School____
- Post secondary training? _____
- Formal training in fishing? Y_____ N_____
  If yes, describe_____
- Have you always been based in this community? Y_____ N_____
- Are you currently skipper_____ or crew_____ or retired_____?
- What year did you start fishing fulltime?
- What was the last season that you fished? _____

- What fisheries have you participated in over your career?
- What types of gear have you used?

Identification

[Show images of the three wolffish species…]

- Which of these have you seen in your fisheries? What would you call them? How do you distinguish between them? (size, colour, flesh, shape, depth, fishery associated with…)

Fishing History

(Now I'm going to get in to your fishing history. I'll ask you about the different fisheries that you've participated in at the beginning of your career and more recently (end or recent seasons).
(When you first started to fish…)

- What were the species you targeted?
- When you started fishing fulltime in (year) did you see wolffish in any of your fisheries?
- Okay – which ones?
  Take out chart or laptop (if using digital charts)
- For each species/fishery where you saw wolffish at the start of your career, please show me grounds where you most commonly fish and where you saw and did not see wolffish on these grounds. Please also tell me the type(s) of wolffish you saw in those areas.
- Describe the gear you were using at the time: type, measurements, mesh size, bait,
- Season you were fishing for that species when you saw wolffish
- Depth in that area,
- Bottom type
- How likely you were to catch wolffish (by species) at that time? (every haul, X times daily, X/week or X over the season for that fishery.
- Anything else you can remember observing about those wolffish at the time?
  - Time in the season when they would start appearing in gear in area X?
  - Size at the time
  - juveniles,
  - migrating
- Anything else you can remember observing about those wolffish at the time?
- When it was brought up what did you do with wolffish in the past?
- Did it have any value? (If yes, where/how?)
- Average landings/sales in this area?

You've fished for X years, what species have you fished in the last few years/did you fish during the last few seasons of your career?

If there were changes- when did the change in species targeted occur? Which species?

Did you change the gear you used to catch the other species over your career?
Describe the change (type, design (hook), mesh size, amount).
Did you notice any changes in wolffish at that time?

For fisheries done throughout- did you change the grounds you fish on? When? Were there wolffish on the new grounds at that time? If yes- can you show me where you saw those wolffish at that time? What kinds of wolffish were these?

For the last few seasons you fished –

- What were the species you targeted?
- Did you see wolffish in any of these fisheries?
- Okay – which ones?
- For each species/fishery where you saw wolffish at the start of your career, please show me grounds where you most commonly fish and where you saw wolffish on these grounds and where you did not see wolffish. Please indicate the type(s) of wolffish seen in each area.
- Describe the gear you were using at the time: type, measurements, mesh size, bait,
- Season you were fishing for that species when you saw wolffish
- Depth in that area,
- Bottom type
- How likely you were to catch wolffish (by species) at that time? (every haul, X times daily, X/week or X over the season for that fishery.
- Anything else you can remember observing about those wolffish at the time?
    - Time in the season when they would start appearing in gear in area X?
    - Size at the time
    - juveniles,
    - migrating
- What do you do with wolffish now?
- Was there a market for wolffish in this area over the last few seasons you fished?
- If yes, species, size limitations, average landings/sales in this area?

In general, over your career, have you noticed any changes in

- The type of wolffish you are catching (species, color)? (Describe what change and when)
- The sizes of the wolffish you are catching?
- The distribution of the wolffish in the areas where you were seeing them? -
    - (shallower or deeper? – can you show me on the chart?)
    - Disappeared from some areas, appeared in some areas where did not see them before (can you show me on the chart?)
- The overall numbers of wolffish in your gear for a particular fishery? If change- can you describe that. When did that happen? (It is possible that landings now are similar to when they started but went down in the middle years)

- How do you release wolffish in specific fisheries?
- Are there any major problems handling and releasing wolffish in specific fisheries?

Listing Opinions

(Next I'll get into your views and experiences since the listing of wolffish. Both the spotted and the northern wolffish are classified as threatened – or at risk of becoming extinct in the future is the situation doesn't change – and the Atlantic or stripped wolffish is classified as a species at risk – or at risk of becoming threatened extinct in the future.)

- When did you begin to hear about problems with wolffish?
- Where did you hear about the listing?
- Were there any discussions about wolffish before the listing?
- How do you feel about the listings?
- Do you agree with the classifications? Do they make sense for your area?

- Based on your experience, what has the impact on local fisheries?
- What has the listing meant for you and your fishery? (regulation changes, changes in boat protocol, location or time changes, etc)
- Did the listing change what people do with wolffish?
- Do you think more wolffish are surviving fisheries now than in the past? Why?

Conservation

(Finally, we're going to get into conservation of the species…)

- Do you know of any programs or people that are working on wolffish education or science in your area?

(If yes)

- Can you describe or name the programs or people?
- Have you been involved with any of these?
- Do you think that they're working (and in what way)?
- If they are not working- why?

- Is all the education and science needed for the wolffish?
- What do you think might work?
- Do others in this area share your opinions?

- Finally, is there anything I haven't asked you about wolffish that is important that you think I should know?

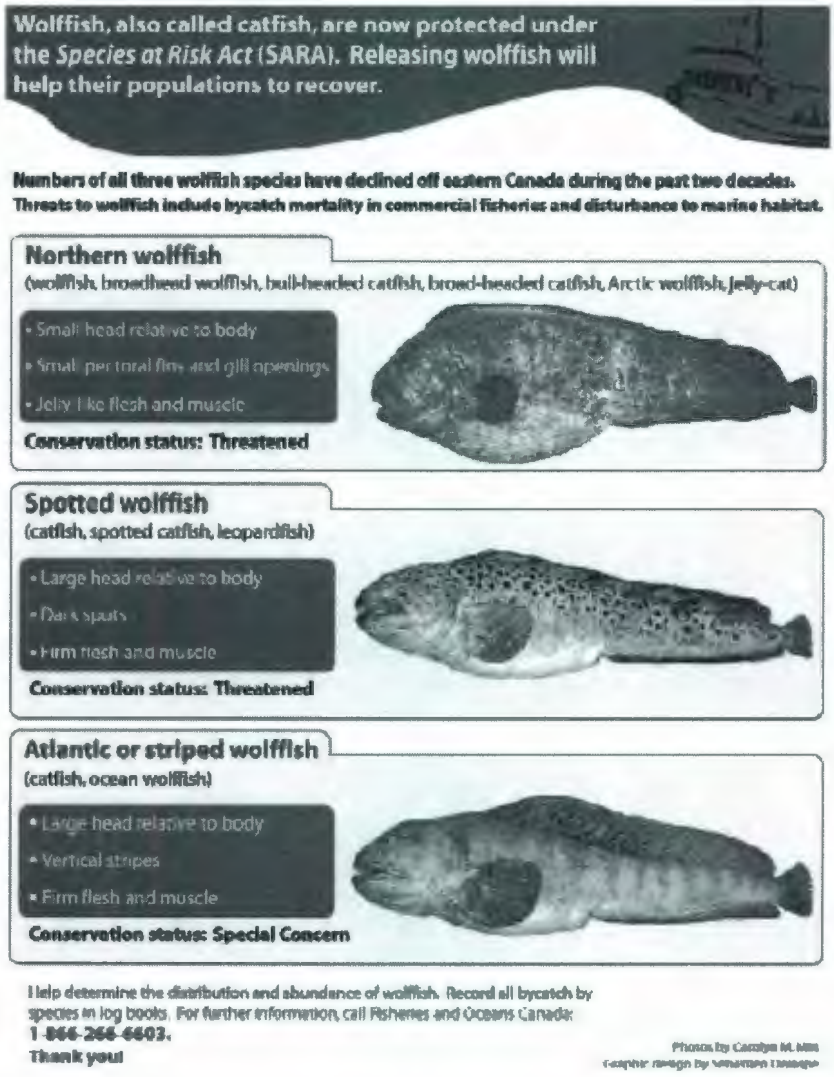
Post-interview

- Leave a copy of the consent form
- Make sure transcripts and charts are labeled with place, date, interviewer initials and interview number

- Keep a master list that has both the actual name of the participant and the associated interview number and store in a separate, password protected file.
- Ask if they wish to have a final plain language report sent to them after the project is finished. If yes- get mailing address or email if they have one.
- Give them a postcard about the CURRA with the CURRA website and indicate information on the project will be posted to that website.

- Ask if they have been releasing wolffish live (if not mentioned)
- Ask if they have been recording wolffish in their logbooks – if not, why not
- Mention wolffish DVD made by Intervale – ask if they want a copy
- Ask if they are interested in being filmed for an educational DVD made by Intervale about cod
- Ask if they know of any good places to film cod underwater

Appendix E: Wolffish identification card, created by Intervale Associates, shown during harvester interviews



Appendix F : Length, appearance and depth of interception of wolffish on onboard observations

Area	Fishery	Species	Length (m)	Appearance	Depth (m)
St. David's	Lobster	*A. lupus*	0.60	Blue colouration, visible stripes	16
Ship Cove	Lobster	*A. lupus*	1. 03	Blue colouration, visible stripes	5
		A. lupus	1.05	Blue colouration, visible stripes	6
		A. lupus	1.0	Dark blue colouration, no stripes	20
		A. lupus	0.60	Dark grey colouration, visible stripes	20
		A. lupus	0.60	Grey colouration, no stripes	10
		A. lupus	0.78	Blue colouration, visible stripes	10
		A. lupus	0.65	Grey colouration, visible stripes	9
Port aux Basques	Atlantic cod	*A. lupus*	0.93	Grey colouration, no stripes	90
		A. lupus	1.0	Blue colouration, no stripes	92
		A. lupus	1.3	Dark blue colouration, visible stripes	105
		A. minor	1.5	Dark grey, visible spots	98
		A. minor	1.65	Dark grey, visible spots	92
		A. minor	1.43	Light grey and yellow, visible dark spots	105
		A. minor	1.78	Light grey, dark spots	98
		A. minor	1.45	Dark grey and yellow, visible spots	97
		A. minor	0.78	Light grey, dark spots	108

		A. minor	1.56	Light grey and yellow, dark spots	97
		A. denticulatus	1.4*	Mottled dark colouration	92
		A. denticulatus	1.8*	Mottled dark colouration	94
		A. denticulatus	1.6*	Mottled dark colouration	106
		A. denticulatus	1.65	Mottled dark colouration	105
		A. denticulatus	1.78	Mottled dark colouration	97

* wolffish observed on the side of the vessel from afar

Appendix G: Summary of harvester profiles

Harvester #	Community	Years fished	Species fished	Gear used	Bait used	Seasons Fished
1	Rose Blanche	13	Lobster, Lumpfish, Cod, Sentinel	Covered pot, gillnet[1], longline (circle hook)	Herring and Mackerel	Summer, Winter
2	Burnt Islands	29	Lobster, Lumpfish, Cod, Sentinel	Covered pot, gillnet[1], longline (circle hook)	-	Summer, Winter
3	Norris Point	27	Lobster, Cod, Salmon, Lumpfish, Snow crab	Covered pot, gillnet [1 2], longline (circle hook)	-	Summer
4	St. Pauls	21	Lobster, Cod, Halibut, Lumpfish, Snow crab,	Covered pot, gillnet [13], longline (circle hook)	-	Summer
5	Norris Point	33	Cod, capelin, Lobster, Snow crab, Mackerel Herring	Covered pot, gillnet[3], longline (circle hook)	-	Summer, Fall
6	Rocky Harbour	39	Lobster, Cod, Lumpfish, Halibut, Snow crab	Covered pot, gillnet[13], longline (circle hook)	Mackerel, Herring, or Squid	Summer
7	Rocky Harbour	35	Cod, Scallop, Lobster, Snow crab, Lumpfish, Halibut	Covered pot, gillnet[13], scallop dragger	Herring	Summer, Fall
8	Woody	39	Lobster,	Covered pot,	Mackerel	Summer

	Point		Cod, Halibut	gillnet[3], longline (circle hook)	and Herring	
9	Norris Point	39	-	Crab pots	-	Spring, Summer, Fall
10	Port aux Basques	21	Lobster, Lumpfish, Halibut, Cod, Sentinel	Covered pot, gillnet[1], longline (circle hook)	Herring, Mackerel, Redfish, Squid	Summer
11	Port aux Basques	30	Lobster, Lumpfish, Snow crab, Cod	Covered pot, gillnet[1], longline (circle hook)	Winter flounder, Herring Mackerel	Summer
12	Codroy	13	Cod, Winter flounder, Lumpfish, Lobster	Covered pot, gillnet[14], longline (J and circle hook)	-	Summer
13	St. David's	32	Lobster, Cod	Covered pot, longline (circle hook)	-	
14	Codroy	22	Halibut, Lobster, Snow crab, Cod, Winter flounder, Grey sole	Covered pot, gillnet[4], longline (circle hook), Danish seine	-	Summer, Fall
15	Codroy	18	Lobster, Cod, Halibut	Covered pot, longline (circle hook)	Herring and Mackerel	Summer
16	St. David's	38	Lobster, Cod, Lumpfish	Covered pot, gillnet[13],longline (circle hook)	Squid, Herring, Mackerel	Summer, Fall
17	St. George	20	Snow crab, Cod, Lobster, Halibut	Covered pot, gillnet[3], longline (circle hook)	-	Summer
18	Ship cove	25	Lobster,	Covered pot,	Herring,	Summer

			Snow crab, Halibut, Cod, Sentinel	gillnet[1], longline (J and circle hook)	Mackerel, Capelin	
19	Stephenville	16	Sentinel, Lobster, Snow crab	Covered pot, longline (Circle hook)	-	Summer
20	Bay of Islands	31	Lobster, Cod	Covered pot, gillnet[3]	Herring and Mackerel	Summer, Fall
21	Bay of Islands	39	Cod, Halibut, Snow crab, Lobster	Covered pot, gillnet[3], longline (circle hook)	Herring and Mackerel	Summer

[1] Lumpfish 10 – 10 ½" to 11-11 ½" mesh
[2] Salmon 5" mesh
[3] Cod 5 ½ - 6" mesh
[4] Winter Flounder 7" mesh

Appendix H : Wolffish habitats as reported by harvesters

Area	**Directed Fishery**	**Bycatch Species**	**Bottom Type [No. harvesters]**
Rose Blanche to Port aux Basques	Cod	All three species	Rocky [n=1]
	Lobster	*A. lupus*	Sand [n=2]
			Rocky [n=3]
Bonne Bay	Cod	*A. minor*	Muddy sand [n=1]
		A. denticulatus	Clean [n=3]
	Lobster	*A. lupus*	Kelp beds [n=2]
			Rocky [n=4]
			Sand [n=1]
		A. minor	Muddy sand [n=1]
			Rocky [n=1]
Codroy to St. David's	Lobster	*A. lupus and A. minor*	Rocky [n=2]
			Sand [n=2]
Bay St. George	Cod	*A. lupus and A. minor*	Rocky [n=2]
		All three species	Sand [n=2]
			Rocky [n=2]
			Kelp beds [n=2]
	Lobster	*A. lupus*	Kelp beds [n=1]
			Rocky [n=2]

Appendix I : Wolffish seasonality as reported by harvesters

Area	Directed Fishery	Bycatch Species	When wolffish were seen in Gear [No. harvesters]
Bonne Bay to St. Paul's	-	*A. lupus*	More around the spring (April) [n=1]
Rose Blanche t Port aux Basqu	Lobster	*A. lupus*	Seen later in the season (June) [n=1]
	Cod	*A. lupus*	Large catches in the first week of June. Dwindle off after the first few weeks [n=2]
		A. minor	Large catches in the first week of June. Dwindle off after the first few weeks [n=2]
		A. denticulatus	Large catches in the first week of June. Dwindle off after the first few weeks [n=2]
Codroy to St. David's	Lobster	*A. lupus*	None in beginning (April), more towards end of the season (June) [n=4]
		A. minor	None in beginning (April), more towards end of the season (June) [n=2]
	Cod	*A. minor*	Deeper towards the fall (September)
Bay St. George	Cod	*A. minor*	Large ones in gear towards July and August. Less in fall (September) [n=1]
		A. denticulatus	Large ones in gear towards July and August. Less in fall (September) [n=1]
Bay of Islands	Lobster	*A. lupus*	Large catches later in season (June) [n=1]
	Cod	*A. lupus*	Large catches in the start of the season (June) [n=1]
		A. minor	Large catches in the start of the season (June) [n=1]
		A. denticulatus	Large catches in the start of the season (June) [n=1]

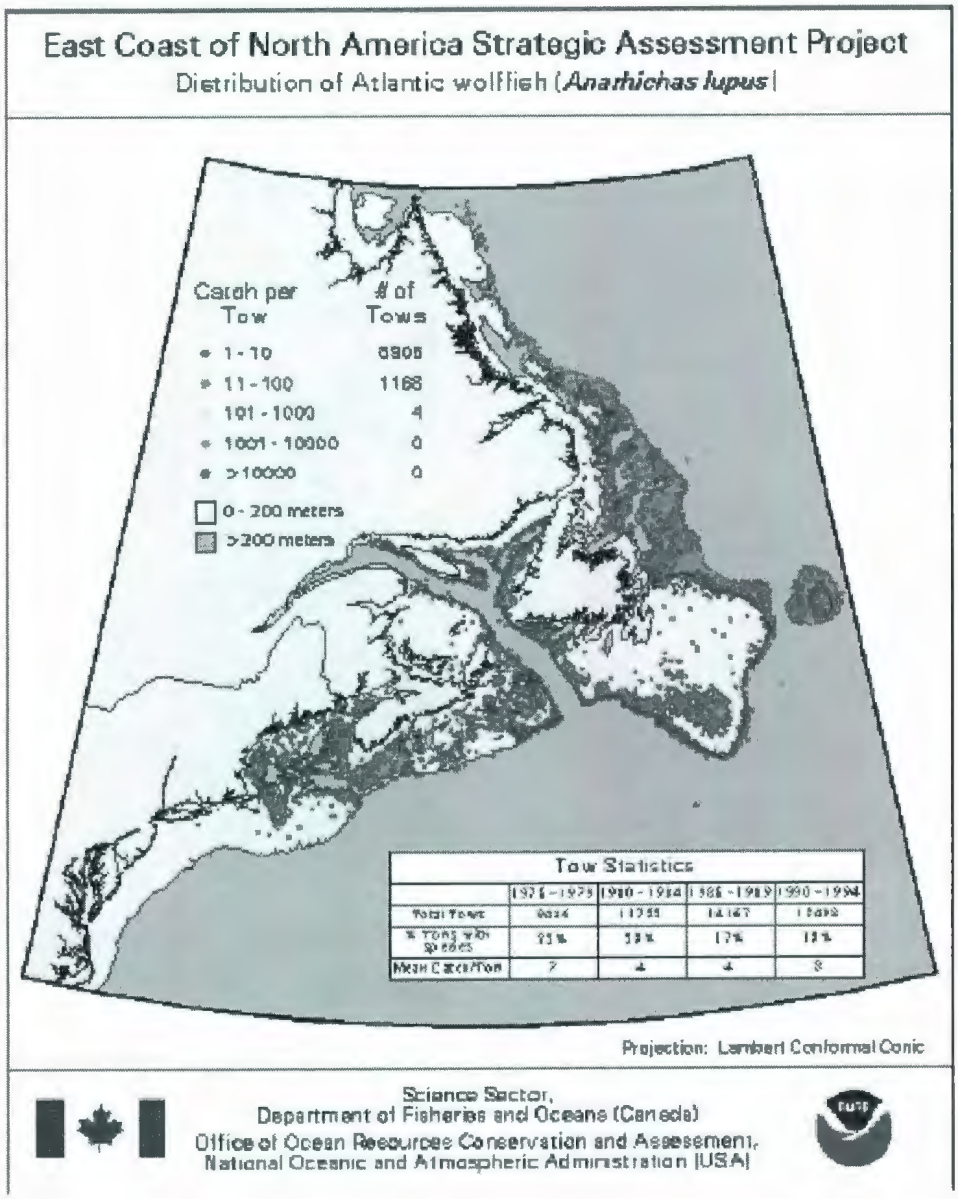
Appendix J: Reported trends in harvester catch rates of *A. lupus*, *A. minor*, *A. denticlatus* by area. Time describes harvester career length, start = beginning of career, end = last season fished.

Area	**Time - Start**	**Stop**	**Wolffish species**	**Trend**
Rose Blanche (3Pn)	1996	2009	All three species	No change
Burnt Islands (3Pn)	1980	2009	All three species	No change
Port aux Basques (3Pn)	1988	2009	All three species	Higher numbers
Port aux Basques (3Pn)	1979	2009	*A. lupus*	Higher numbers
			A. minor	Lower numbers
			A. denticulatus	
Codroy (4R)	1996	2009	All three species	Not answered
Codroy (4R)	1987	2009	All three species	No change
Codroy (4R)	1991	2009	All three species	Higher numbers
St. David's (4R)	1977	2009	All three species	Higher numbers
St. David's (4R)	1971	2009	*A. lupus*	Higher numbers
			A. minor	Lower numbers
			A. denticulatus	
Bay St. George (4R)	1989	2009	All three species	No change
Bay St. George (4R)	1984	2009	*A. lupus*	Higher numbers
			A. minor	Lower numbers

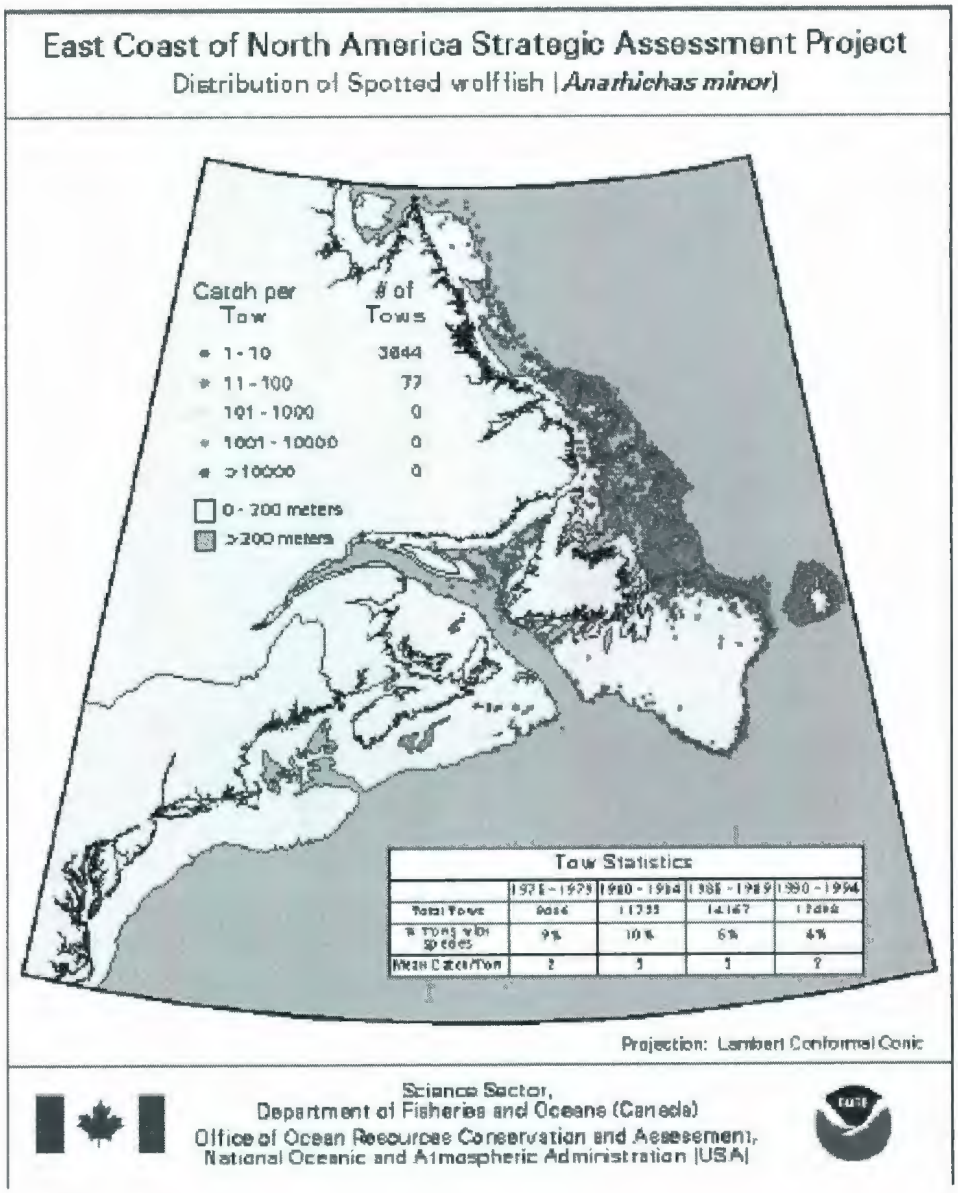
			A. denticulatus	
Bay St. George (4R)	1993	2009	All three species	Higher numbers
Bay of Islands (4R)	1978	2009	*A. lupus*	Higher numbers
			A. minor	Lower numbers
			A. denticulatus	
Bay of Islands (4R)	1970	2009	*A. lupus*	No change
			A. minor	Lower numbers
			A. denticulatus	
Bonne Bay (4R)	1976	2009	All three species	Not answered
Bonne Bay (4R)	1970	2009	All three species	Higher numbers
Bonne Bay (4R)	1974	2009	All three species	No change
Bonne Bay (4R)	1970	2009	All three species	Higher numbers
Bonne Bay (4R)	1970	2009	*A. lupus*	Higher numbers
			A. minor	Lower numbers
			A. denticulatus	
Bonne Bay (4R)	1982	2009	*A. lupus*	Higher numbers
			A. minor	Lower numbers
			A. denticulatus	
St. Paul's (4R)	1988	2009	*A. lupus*	No change

			A. minor	Lower numbers
			A. denticulatus	

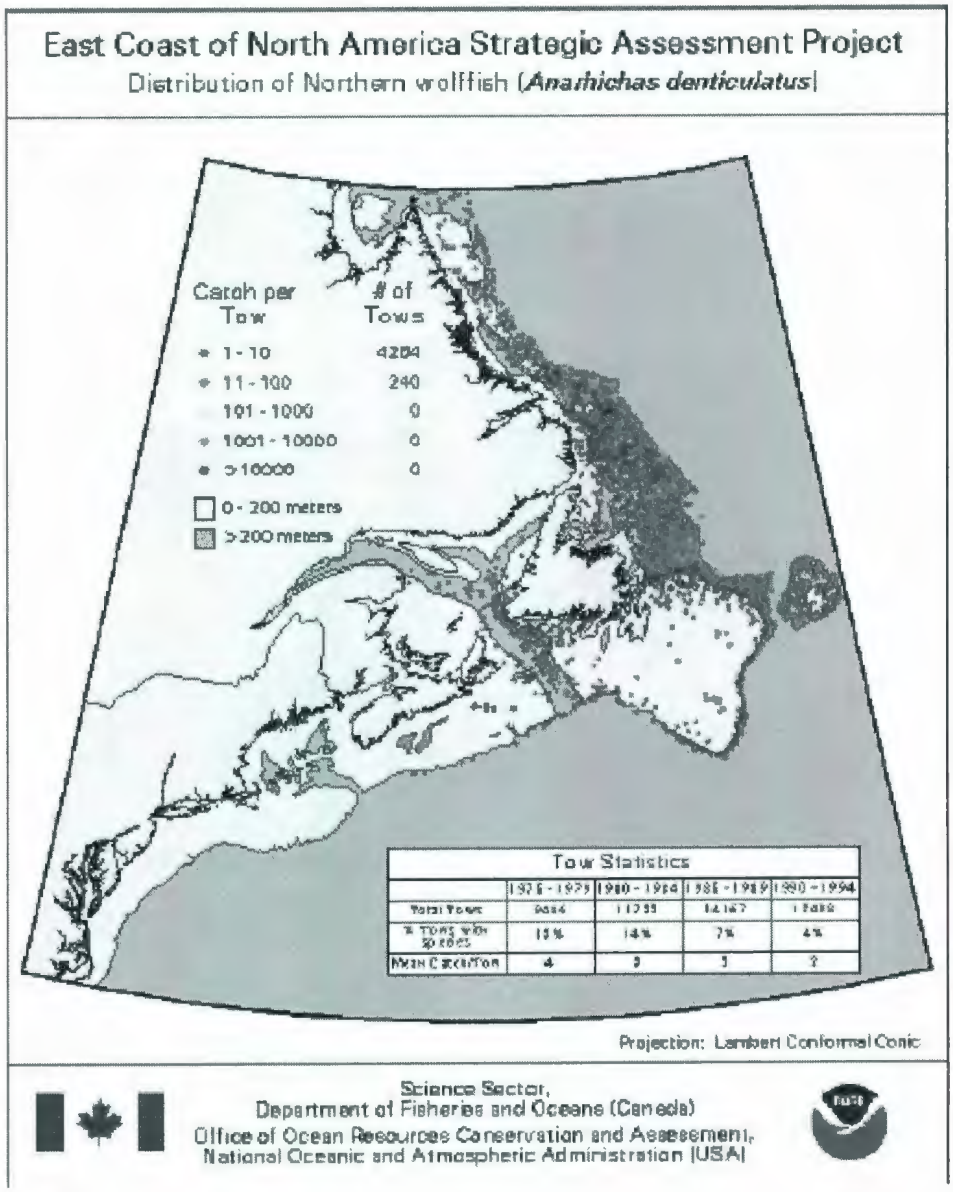
Appendix K : ECNASAP Groundfish Atlas distribution maps for a) *A. lupus* b) *A. minor*, and c) *A. denticulatus*.



a)


East Coast of North America Strategic Assessment Project
Distribution of Spotted wolffish (Anarhichas minor)
Catch per Tow
# of Tows
1 - 10 3844
11 - 100 77
101 - 1000 0
1001 - 10000 0
>10000 0
0 - 200 meters
>200 meters
Tow Statistics
1971 - 1979
1980 - 1984
1985 - 1989
1990 - 1994
Total Tows
9654
11733
14167
13898
% Tows with species
9%
10%
6%
4%
Mean Catch/Tow
2
3
3
2
Projection: Lambert Conformal Conic
Science Sector,
Department of Fisheries and Oceans (Canada)
Office of Ocean Resources Conservation and Assessment,
National Oceanic and Atmospheric Administration (USA)

b)


East Coast of North America Strategic Assessment Project
Distribution of Northern wolffish (Anarhichas denticulatus)
Catch per Tow
# of Tows
1 - 10
4284
11 - 100
240
101 - 1000
0
1001 - 10000
0
>10000
0
0 - 200 meters
>200 meters
Tow Statistics
1975 - 1979
1980 - 1984
1985 - 1989
1990 - 1994
Total Tows
9664
11055
14167
13889
% Tows with species
15%
14%
7%
4%
Mean Depth/Tow
4
3
3
?
Projection: Lambert Conformal Conic
Science Sector,
Department of Fisheries and Oceans (Canada)
Office of Ocean Resources Conservation and Assessment,
National Oceanic and Atmospheric Administration (USA)

c)

Appendix L
PARTICIPANT CONSENT FORM FOR INTERVIEWS WITH KEY INFORMANTS

I am a graduate student at Memorial University. This research is a part of my Master's project. The research is part of the CURRA (Community-University Research for Recovery Alliance) initiative. CURRA is funded by SSHRC (Social Sciences and Humanities Research Council) and involves researchers in both the natural and social sciences from Memorial University. Dr. Barbara Neis is the Principal Investigator on the CURRA and my co-supervisor, along with Dr. David Schneider. A number of community partners are also involved with the CURRA project. These partners included the Fish Food and Allied Workers Union, the Department of Fisheries and Oceans, Intervale Associates (Kathleen Blanchard) and the Integrated Coastal Zone Management Initiative.

The application of the Species at Risk Act to marine fisheries is relatively new. Wolffish were the first listed marine fish species under this Act. Many species have been proposed and not listed so the wolffish seems to be somewhat unique. A central purpose of my masters research is to use the wolffish listing case to understand how the process that existed at the time functioned (including its strengths and weaknesses); compare that process to the one that exists now; to learn more about recovery initiatives since the wolffish (who, what, how effective) listing and about the potential/likelihood and process for delisting; and, where appropriate, identify ways to improve the listing process in the future. In doing this research, we are starting from the assumption that there may be future listings and would like to document any lessons learned from this early case.

For the part of this research dealing with the listing process, we will be reviewing listing documents and doing interviews with people like yourself who are knowledgeable about that process to:

9. understand the process that existed at the time of the listing (including its strengths and weaknesses);
10. compare that process to the one that exists now;
11. learn more about the how the process has actually worked itself out on the ground in terms not only of the listing, but also stewardship and other initiatives since the listing; and,
12. your thoughts on the likelihood, risks and benefits and the process that should be followed in the event of any potential future de-listing.

In other parts of the research for my thesis, I will be analysing DFO research vessel survey data and interviewing fish harvesters in the Northern Gulf to

13. learn more about wolffish in the Northern Gulf of St. Lawrence;
14. learn more about the consequences of the listing for local fish harvesters;
15. learn their views on the likelihood and pros and cons of a future de-listing.

You are being asked to consent to participate in a phone interview for the portion of my research concerned with the listing process, events since the listing and the potential for, and pros and cons of a future de-listing.

If you volunteer to participate in this phone interview, we will ask you to describe your involvement with the wolffish listing process, including the initiation, actual listing, and developments since the listing and to reflect on that process and its outcomes. We will also ask you about your thoughts on wolffish population structure, abundance trends and spatial distribution, your knowledge of wolffish in the Northern Gulf and your thoughts on future directions and ways to improve the listing process.

Following this interview, if you are interested in reviewing a draft copy of the resulting plain language report and in having a final copy, copies can either be sent or emailed to you.

The interview will be done by phone and should take approximately 45 minutes but the exact length will depend on how much you have to say.

Participation in this phone interview is free and voluntary. You may refuse to participate, refuse to answer any specific question, and you may leave the interview at any point. You are also under no obligation to explain your answers or decisions and can leave the study in the future if you change your mind about participating. If you decide to leave the study, the notes from this interview will be destroyed.

The list of people interviewed for this project will be kept confidential and your name will not be used in any presentations reports or publications resulting from this research unless you explicitly indicate that you wish your comments to be placed 'on the record'. If you indicate in the interview that there are certain comments you would like to be 'on the record' this means your name and affiliation will be included in any reports and publications where those comments are cited

You should be aware that comments that are not placed 'on the record' might be perceived as coming from you by people familiar with you and your role in the listing.

Each interview will be assigned a number and the master list of names and contact information will be kept in a separate, secure cabinet, away from the interview notes.

We are not aware of any risks to you from participating in this interview. Participation gives you an opportunity to contribute to research about the listing process, ideas about its strengths and weaknesses and potential ways to improve it in the future.

At the end of the interview, you will be asked to decide what should happen to the notes taken during this interview after the completion of the research.

PARTICIPANT CONSENT FORM FOR INTERVIEWS WITH KEY INFORMANTS

I have read and understand the information in this consent form ____ Yes/ ___ No

I understand I will have the opportunity to ask questions about the process prior to and during the phone interview ____ Yes/ ____ No

I understand I have the right to refuse to answer any questions put to me ____ Yes/ ____ No

I understand I have the right to withdraw from this research during or after the interview and, should I withdraw, that the interview notes will be destroyed ____ Yes/ ____ No

I understand that if I indicate in the interview that there are certain comments I would like to be 'on the record' this means my name and affiliation would be included in any reports and publications where those comments are cited ____ Yes/ ____ No

I hereby consent to participate in this study.

_____	_____	_____
Name of participant	Signature of participant	Date
_____	_____	_____
Name of Researcher	Signature of Researcher	Date

I would like an opportunity to review and comment on a draft plain language report from this research ____ Yes/ ____ No

I would like to receive a final copy of the plain language report from this research ____ Yes/ _____ No

If yes, my email address is _____.

This research is being supervised by:
Dr. Barbara Neis
Department of Sociology, Memorial University
bneis@mun.ca
(709) 737-7244
The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 737-8368.

ARCHIVAL DEPOSIT FORM

Once the research project is complete, it is up to you what is done with the interview notes. However, as part of the research integrity policy at Memorial University, interview materials must be kept in a secure location by the researchers for 5 years after completion of the master's thesis and any related publications.

The information you provide may also be a valuable resource for other, future researchers. If you are willing to have a copy of the interview notes made available to other students and researchers from Memorial University, please indicate below. If you agree to deposit the interview notes for future use, please keep in mind that the list of names will remain confidential. Therefore anyone using this resource would not be permitted to use your real name in any published document, public presentation, or any other publicly accessible media without your permission. You can also request that future researchers only have access to the interview notes with your written permission.

If you are uncomfortable with any of the above options, you may ask to have the interview notes retained only by the research team, or even destroyed after the completion of the project and publications as well as the 5 year retention of data for research integrity required by Memorial.

Finally, you may wish to receive a copy of the interview notes for your own personal records.

Please check your preferred options below.

I hereby authorize:

OPTION 1:_____ Placement of the interview notes in the Memorial University Folklore Archive at Memorial University.
E. Access up to the discretion of the Archivist _____
F. Access only with my written permission_____

OPTION 2:_____ Retention and use of interview notes only by the research team

OPTION 3:_____ Destruction of the interview notes after the completion of the project and the required delay for research integrity.

OPTION 4: Do you wish to have a copy of the interview notes sent to you?
YES_____ NO_____

If yes, please provide your email address: _____

Name_____ Signature_____ Date_____

Signing of behalf of Memorial University:

Name_____ Signature_____ Date_____

Appendix M
INTERVIEW PROTOCOL FOR KEY INFORMANTS

First contact (Email)

Hi. My name is Jennifer Dawe. I am a graduate student in Environmental Science at Memorial University working with the Community-University Research for Recovery Alliance, an initiative funded by the Social Sciences and Humanities Research Council.

I am working on a project with Dr. Barb Neis that is part of the research for my Masters of Environmental Science. This project is exploring the relatively recent listing of three species of Wolffish under the Species at Risk Act, developments since the listing, trends in Wolffish abundance in the Northern Gulf of St. Lawrence and the likelihood and pros and cons of a future de-listing. Wolffish were the first listed marine fish species under this Act. Many species have been proposed and not listed so the Wolffish seems to be somewhat unique.

The purpose of this research is to use the Wolffish case to understand the process that existed at the time of the listing (including its strengths and weaknesses); compare that process to the one that exists now; and to learn more about the how the process has actually worked itself out on the ground in terms not only of the listing, but also developments since the listing and any potential future de-listing.

You have been identified as someone who has experience with the Wolffish listing process and/or has been part of follow up activities since the listing. Dr. Barbara Neis and I would like to do a phone interview with you to determine your experience with this process, your observations on what has happened since, and the merits and possibility of de-listing in the future.

The interview will take approximately 30-45 minutes to complete and will be strictly confidential – no names or direct personal information about you will be used and quotes will not be attributed to you in any reports, theses or publications from this research unless you indicate you would like to put some things "on the record".

Participation in this research is free and voluntary. Should you agree to participate, we will email you a consent form to review, sign and fax back to us. If you consent to participate, you will be free to refuse to answer particular questions or to withdraw from the study at any time. Would you be interested in participating? If yes, can you give me your email address so I can forward the consent form to you? Also, is there a time that would be best for you to complete this interview?

Interview Schedule

Ethics

- Email the consent form to the participant. At the start of the interview, review with them the main elements of the consent form that they have signed. Remind them that they have the right to decline to answer any question without justification and that they have the right to withdraw from the research at any time. Should they withdraw, the interview notes will be destroyed.
- Remind them that their signature indicates that he/she understands what the research is about, that their participation is completely voluntary, and that they are consenting to being interviewed. Suggest they keep a copy of the consent form for their files.
- Remind them of the part of the consent form about willingness to provide feedback on the results of this research. If they are willing to comment on the draft report ensure they have provided a mailing address or email address and record it on the consent form indicating that they are willing to review a draft report.
- Confirm that they do/do not want to receive a copy of the interview notes for their own files.
- Indicate that a final plain language report based on this research will be posted to the CURRA website which can be accessed through the Bonne Bay Marine Station website at http://www.bonnebay.ca/ and can be emailed to them if they would like.
- If they would like to receive a copy, ensure their email address is recorded on the consent form.

INTERVIEW PROTOCOL FOR KEY INFORMANTS

As you already know, this interview is part of a larger study using a case study of Wolffish in the Northern Gulf and the Wolffish listing process to: a) gather insights into how that process worked and any changes in the process since the Wolffish listing; b) explore strengths and weaknesses in the listing process and in post-listing recovery initiatives from the point of view of multiple stakeholders; and, c) explore stakeholder reflections on the potential future de-listing of wolffish, its appropriateness and insights into a reasonable de-listing process. In doing this research, we are starting from the assumption that there are likely to be future listings and would like to document any lessons learned from this early case.

In our phone interview, we would like to explore with you your knowledge, where relevant, of the listing process, developments since the listing, any opinions or thoughts you might have about ways to improve this process in the future and any reflections you

might have on the likelihood, prospects and process for a future delisting of the three Wolffish species.

(If asked why we are doing this/if contested: In order to understand the outcomes of the COSEWIC/SARA listing process and to properly understand local thoughts and experiences with the process, we need to fully understand what went on during the listing process, the different stages, who was involved, and what it means for a species to be listed.)

Starting off, can you describe for me your involvement with any phase of the Wolffish listing process (initiation of the process, actual listing, developments since the listing)

For each area where they were involved, ask them:

a) how they got involved,
b) what their role was,
c) any reflections about each part of the process they were involved with
d) any reflections they might have about other parts of the process they were not directly involve with
e) any comments they might have on the process overall.

So, if involved with **COSEWIC**

a) Tell us about COSEWIC – its history, involvement with the listing of marine species,
b) Tell us about the nature of your involvement,
c) What was happening at the time you were involved related to listing of marine species,
d) Any reflections you might have on the COSEWIC process at that time and its outcomes related to Wolffish
e) Reflections on changes in COSEWIC and the listing process since that time they would like to comment on.

If involved with **SARA**

a) Tell us about SARA – its history, involvement with the listing of marine species,
b) Tell us about the nature of your involvement,
c) What was happening at the time you were involved related to listing of marine species,
d) Any reflections you might have on the SARA process at that time and its outcomes related to Wolffish
e) Reflections on changes in SARA and the listing process since that time they would like to comment on.

If involved with recovery and stewardship initiatives for wolffish

a) Tell us about these initiatives – what they involve, where they focus
b) Tell us about the nature of your involvement,

c) What was happening at the time you were involved related to listing of marine species,
d) Any reflections you might have on its outcomes related to Wolffish
e) What do you feel is the next step for this process? - Are there any further developments that should be done?

Ultimately, the fish harvesters and the fishing communities are primarily affected by the listing of a marine species and may have strong opinions on it. Based on your experience what involvement, if any did harvesters have in the listing process?

Do you think this involvement (or lack thereof) was appropriate? Helpful?

Do you think it has had any influence on developments since Wolffish were listed (for these and other marine species)?

The listing of the Wolffish seems to be a very unique case. Based on your experience and what you have observed, why have so few marine species been listed?

Should COSEWIC be assessing marine fish at all? Should there be a separate program with separate criteria?

If Wolffish were to be listed now, how would this work?

One issue that has been raised in relation to the listing is that the data that informed the listing came from RV data which are drawn from deeper water areas.

- Is this your understanding?
- Do you see any problem with the generalizing from RV data to coastal and more shallow areas?
- More generally, do you have any thoughts on the likelihood of variability in Wolffish abundance trends across areas? Reasons for this variability? (vary by species?)
- Thoughts on the population structure of Wolffish (vary by species?)
- And finally, related to above, thoughts on the most appropriate spatial scale for Wolffish listings (bay level, regional level?)
- What about thoughts on natural versus fisheries induced variability for Wolffish?
- General factors most responsible for declines in Wolffish abundance?
- More generally, do you have any thoughts on the essential data requirements for listing?
- Factors most essential to recovery?

Jennifer's Masters research will include a section on perceptions of trends in Wolffish populations in the Northern Gulf of St. Lawrence (3Pn, 4R, 4S).

- Do you have any sense of the extent to which data from the Northern Gulf were used in the listing process for Wolffish?
- What about the nature of the data that they had to draw upon?
- Do you have any experience with/knowledge of the situation in the Northern Gulf? If yes, can you describe that experience/knowledge.
- Do you think there is any reason to think there might something going on in the Northern Gulf that might make the situation there different from elsewhere?

As the listing process of SARA is relatively new, to our knowledge no species are considered to have recovered? Is that the case?

Related to this, to our knowledge none have been delisted?

- From your point of view, what would recovery of Wolffish look like?
- In the case of Wolffish, how much recovery would, in your opinion, be needed to make de-listing appropriate?
- What would it take to achieve that level of recovery?
- I am also interested in any ideas you might have about an appropriate de-listing process. Measures would need to be taken by the government and the industry to ensure that these species are protected and continue to recover.
- Timeframe
- More generally, from your point of view what would be some of the merits for a de-listing? Some of the problems with de-listing?

And finally, is there any I haven't asked you yet about the listing process, recovery initiatives and delisting that you think is important and that I should include in this work?

Post Interview

- Thank the participant.
- Ensure you have a signed copy of the consent form for the files.
- Suggest they save a copy of the consent form (saved on computer, saved fax copy for themselves).
- Compile all notes taken from all interviewers, update list of key informants, store list separately from notes.